Electrical Review

WITH WHICH IS CONSOLIDATED WESTERN ELECTRICIAN AND ELECTROCRAFT.

VOL. 74.—No. 16. CHICAGO, SATURDAY, MARCH 19, 1919. PAGE 617.

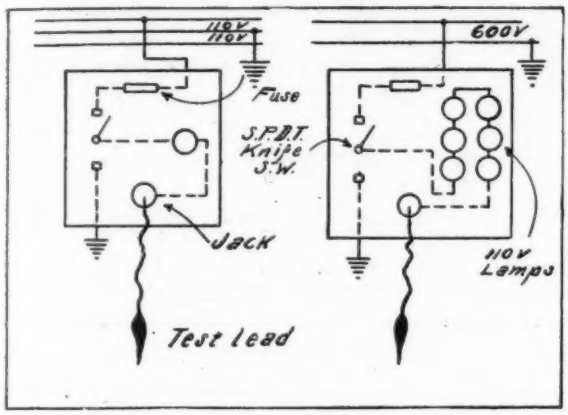


Fig. 1.—Testing Panels.

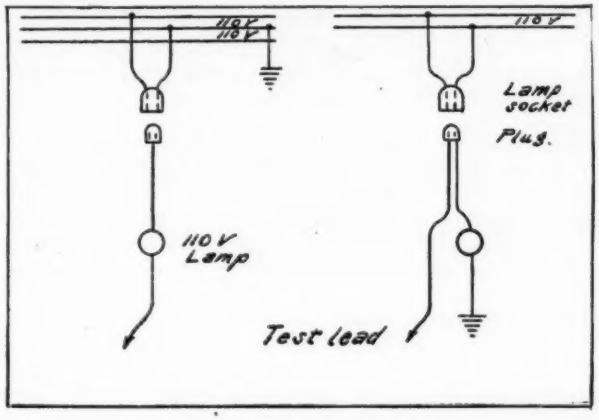


Fig. 2.—Split Extension Cords.

Phase and Fault Testing by Means of Lamp Signals

Methods of Using Lamps in Testing for Grounds, Short Circuits and Continuity of Underground Cables—Methods of Checking-up Phases and Identification—Apparatus for Making Tests

By FRANK GILLOOLEY

IN NEW or repair work on multi-conductor cables, if the proper phase relations have not been maintained in the splice, the "twist" must be corrected at the pothead at either end of the cable. Frequently, the pothead will have to be opened and the conductors rearranged. A system whereby the splicer, knowing the phases, can make them continuous in the proper sequence, has many advantages. In new work, permanent construction may be made at both ends of the cable; in repair work, no changes are necessary at either end; on a cable made up of several sections, only one splice need be reserved as the test-splice; no time is lost correcting reversed phases.

Many large companies have various system of lamp signalling in use whereby the phase or polarity of each conductor is furnished the splicer at the joint, and after the conductors have been made continuous the phases are checked before the joint is sealed. The system described here is also used for determining the nature of the trouble on a faulty cable, and on various station apparatus, and has been satisfactorily employed for a number of years. The testing potential is 110 volts alternating-current or direct-current from commercial stations, and 600 volts direct-current from railway stations.

Three separate tests are used: Ground and short-circuit test; flash or phase test; check-up or continuity test.

The test for ground and short-circuit is made immediately before any of the others and insures that the conductors are free of each other and of ground. No cable is turned over for repairs until the exact nature of its defect has been ascertained from these tests. Any doubtful cable on which no trouble is apparent on the lamp tests is given a breakdown test by applying high voltage between phases and between all conductors tied together and ground. If the cable withstands the prescribed testing pressures it is returned to service; if it shows distress, the high voltage is applied until the cable is broken down sufficiently to reveal its defect on the lamps. After the faulty conductors have been apprehended, a test for continuity is made to determine whether they have been burned open.

The phase test is given from the stations to the manhole and identifies the phase of each conductor for the splicer's guidance in making the joint. Before the joint is wiped, a check is made on his connections by flashing between the stations on each side of the splice.

APPARATUS USED.

Each station is equipped with one or more testing

panels located within sight of the point at which tests are made. On the 110-volt panel is a double-throw, single-pole knife switch, selecting either "feed" or "ground"; a jack into which the testing cord fits; and one 110-volt lamp. The same size of lamp is used on all panels. The 600-volt panel has, of course, a bank of six lamps in series, instead of one. The test lead is of heavy pointed copper, to permit of a tight contact when testing, and is protected by a wooden handle similar to a screw driver. Each cord fits all jacks.

The splicer's equipment consists of two short pieces of wire, with one 110-volt lamp connected between them; one wire being used as the test lead, the other to make the ground connection.

Method of Testing.

In any test, current is supplied from only one point. The man who supplies the current gives the test; the man furnishing the ground receives the test. Three flashes are made on each conductor by the man giving the test, and are answered on that conductor by the man receiving the test. The man giving the test furnishes the phases, which are identified by the order in which they are flashed on: "A" phase first, "B" second, and "C" last. In the test for ground and short-circuit no specific flashes are made, because any indication on the lamp in this test is sufficient proof of the existence of a fault.

Ground and Short-Circuit Test.—The switch is placed on "feed," connecting one side of the lamp to the 110-volt supply—with the 600-volt outfit, the six lamps are connected in series to the 600-volt supply. The operator touches his test lead to a known ground, completing the circuit and lighting his lamp;

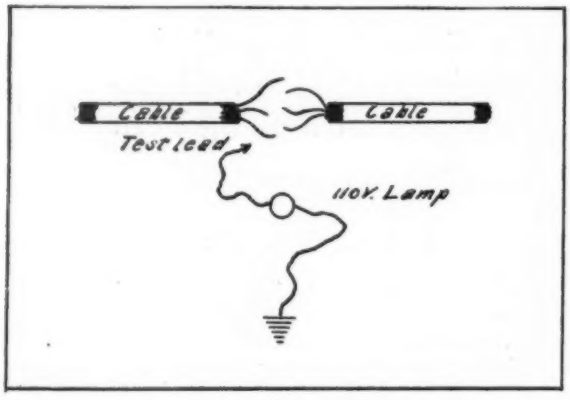


Fig. 3.—Splicers' Receiving Set.

thus checking his testing circuit. The lead is then placed on each conductor in turn, and if no light appears the conductors are considered free of ground. One conductor is grounded through a piece of wire to the known ground, and the test lead applied to the other two; the absence of indication on the lamp showing the conductors to be free of each other.

Should a ground exist on any of the conductors, the circuit would be completed through the lamp, the cable ground, the station ground, back to the supply; and the lamp would burn to a degree of brilliance depending on the resistance of the ground on the cable. A high resistance ground will not show up on this low-voltage test; so that, if a cable is at all doubtful it is always given a break-down test before being replaced in service.

Flash, or Phase Test.—This test is made on the cable from stations on opposite sides of the splice, and furnishes the phases to the splicer. Each station gives the test, the splicer receiving them both.

The operator throws his switch to "feed," tests his lamp, and makes the ground and short-circuit test on the cable. Placing his test lead on the "A" phase conductor, he waits for the splicer to pick him up.

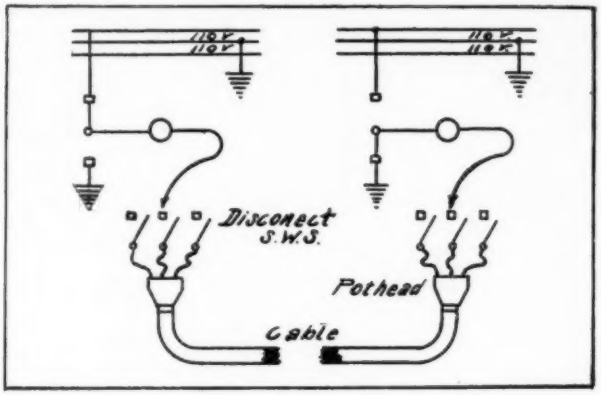


Fig. 4.—Connections of Testing Circuit. "A" Giving a Test. "B" Receiving a Test.

The splicer touches his lead to each conductor on the end of the cable on which he is to receive the test until he gets a light. When he touches the conductor on which the operator is waiting for him, the circuit is completed through the two lamps and ground, and each lamp comes to one-half normal brilliance—in the 600-volt system, seven lamps are thus connected in series through ground.

When the operator gets a light he flashes slowly and distinctly three times; opening and closing the circuit by touching and removing his test lead from the conductor. Replacing his lead on that conductor, he receives the splicer's answering three flashes; the splicer making and breaking the circuit exactly as he had done. The "A" phase conductor is thus made known to the splicer, and he marks it by tying one piece of linen tape, or ribbon, on it. The "B" phase conductor is flashed on in the same manner and marked with two pieces of tape; then the "C" phase is flashed on and marked with three pieces of tape.

One end of the cable is thus marked, and the splicer goes in on the other end and receives the same test from the operator of the second station. All of the conductors are then identified.

Check-up Test.—After he has connected and soldered his conductors, the splicer calls for a check on his connections, and the system operator advises the two stations which is to give and which is to receive the test. After checking his lamp and testing for ground and short-circuit, the man giving the test places his lead on conductor "A" and waits for the other to pick him up. To avoid confusion, the man giving a test is the only one who makes a ground and short-circuit test. The man receiving the test, first checks his lamp, then changing his switch from "feed" to "ground," touches each conductor until he gets a light; returning the three flashes he receives on each conductor.

The man receiving the check-up test is responsible for its correctness. He must note carefully the order in which the phases are flashed on. Should he receive either "B" or "C" first, it would show that that phase was reversed with the "A"; or, receiving the "C" before the "B", that those two phases were crossed.

With such information, the splicer is enabled to make quick and accurate corrections.

After a faulty cable has revealed its damage on the ground and short-circuit test, the check-up test is always made for continuity between stations; inability of the man receiving the test to obtain a light on any conductor, showing that that conductor had been burned open.

With such a system of lamp signalling, a schedule can be devised for making known the phase or polarity of each of any number of conductors in a cable. The lamps should all be of the same size to secure uniform brilliance, which is essential to accuracy in the tests. Were the lamp of the man receiving a test to appear too dim, it would evidence the existence of a partial ground on the cable somewhere between the two testing points. A ground on any conductor of the cable might complete the testing circuit of the man giving the test without including in the circuit the lamp of the man receiving it; and would light the lamp of the first man to a point of brilliance corresponding to the conductivity of the cable ground. It is for this reason that the ground and short-circuit test immediately precedes any other test. Difficulty is sometimes experienced with new men flashing indistinctly, thereby creating a doubt in the mind of the other man on the test and necessitating its being repeated.

This system is also used for testing overhead lines. The ground and short-circuit test and the continuity test usually are the only ones required on such feeders. On extremely long lines of relatively small conductors, with the 110-volt outfit one of the lamps may have to be cut out to get satisfactory results.

Split extension cords may be substituted for regular testing panels. On an ungrounded lighting circuit a two-wire cord is necessary; the lamp in series with one wire to ground, the other wire used as the test lead. With grounded-neutral lighting systems, only one wire with the lamp in series with it is necessary; this wire being connected to the ungrounded side of the supply.

Operators should be required to wear rubber gloves while making the tests, and to always test the conductors for potential by approaching them with the metal end of a switch-hook for a static spark. The tests should be made at the line disconnecting switches, so that no transformers or regulators on the cable in the station may form a path between the phases; and for this reason, the tests can not be made on distribution feeders having transformers connected to them out on the line.

The tests have proved valuable in locating trouble on various circuits and apparatus throughout the station. A short-circuit or a ground may be apprehended in the winding of any piece of apparatus or any circuit by the same process used on cables. Similarly, an open circuit may be found on the continuity test, or by grounding the far end of the circuit or winding and then making the ground test. The phase test has been utilized during the installation and repair of various lighting, power, and control circuits. In fact, a multiplicity of uses have been found for these tests.

PHASING-OUT NOMENCLATURE.

In phasing-out alternating-current cables, discrimination should be made between "flashing phases" with a lamp with low voltage and when operating a feeder voltage regulator up and down, thus varying the voltage. Where this discrimination is not made, and an inexperienced operator is at work alone, a danger is introduced on account of the possibility of his trying to use a lamp on a "live" circuit. The lamp test should be understood as a "flash phases" and the regulator or voltage variation test as an "identify phases." The Commonwealth Edison Co. determined to adopt the above nomenclature as a safety measure, necessitated by the fact that their cable splicers and operators sometimes worked on the direct-current and sometimes on the alternating-current system.

BOOSTING FACTORY LIGHTING BY NEWSPAPER ADVERTISING.

Commonwealth Edison Capitalizes Its Tests of Factory Lighting.

The ELECTRICAL REVIEW in the issue of March 22 described the results of some illumination surveys made in some factories by the Commonwealth Edison Co. The results showed that by the adoption of proper illumination, which is rarely found until the matter is attacked by the utility, factory production can be increased from 10 to 30%.

With high wages, high material costs, it behooves the factory management to increase production in every way feasible that tends to reduce the cost of production. Improved lighting is probably the cheapest way, since the cost of the additional lighting is usually negligible as compared to the lower cost of production or increased production. The Commonwealth Edison Co.'s factory lighting tests that attracted so much attention among the central station and lighting men, are now being capitalized by the utility. One method of telling about its factory lighting surveys is shown herewith.

Offset High Operating Costs with Better Factory Lighting
22%
GREATER PRODUCTION
HIGH wages as well as high cost of materials make it imperative that every manufacturing plant be operated at maximum efficiency. Nothing so greatly promotes efficiency as
Modern Factory Lighting
—First, by positively increasing production from 10 to 30 per cent, as proved by carefully compiled statistics; second, by reducing spoilage 25 per cent or more.
For even and well diffused illumination without glare the unit illustrated is highly recommended.
Our illuminating engineers will gladly analyze your lighting facilities and suggest improvements entirely without obligation. Telephone Randolph 1300 Today—Local 109—Illuminating Division—Contract Department.
Commonwealth Edison Company
EDISON BUILDING—72 WEST ADAMS STREET

Commonwealth Edison Co.'s Factory Lighting Advertisement Tells the Tale.

Influence of Chemistry Upon Improvement in Stoker Design

Fundamentals of Chemistry of Combustion—Application of the Chemistry of Combustion to Existing Stoker Design—Requirements of Stoker that Meets Theory of Combustion

By CLYDE H. McCLURE

Chemical Engineer.

AS A RESULT of the economic pressure produced by the increased cost of labor and material, there has developed a keen interest in efficiency of factory management and production. Since it is apparent that wages may not be reduced and prices maintained, and prices cannot be lowered without a reduction in the cost of production, the evident solution lies in the economical use of raw material with which this country is so richly endowed. There is no doubt that the American manufacturer can still maintain his profits without resorting to the old expedient of reduction of wage scales, if he will but give proper attention to this vital question.

The manufacturer is usually quite familiar with the characteristics of most of the materials which he uses in his business and his methods and processes are matters of daily study so that, in looking over his plant with a view to increased efficiency, he naturally lands on the one department, the inner working of which is to him more or less of a mystery. In most manufacturing processes power is a large item. Coal is high priced and its economical use offers a greater opportunity for direct saving than any other one thing in connection with the manufacturing process.

Of the number of important considerations which influence the economy of power generation, the proper burning of the coal is the starting point. Much progress has been made in the development of mechanical devices designed to feed coal automatically and regularly to the furnace. These devices have been designed by men trained in mechanical engineering, who have developed to a high state the art of feeding coal and removing refuse.

The burning of coal to produce heat is, however, a chemical operation, and in order to achieve efficient results, it is necessary to employ apparatus designed to meet the requirements of the chemical laws involved in the process, as well as the mechanical needs.

From the viewpoint of the chemical engineer, it appears that future improvement in mechanical stokers, especially for the territory dependent upon Indiana and Illinois coals, lies in a combination of the best feature of the two types which have thus far proven most efficient, *i. e.*, the chain grate and the underfeed. Neither provides proper means for distribution of the air supply to the burning fuel, a defect which has been remedied to a considerable extent by the costly expedient of very high boiler settings. The air supply of the underfeed is admitted through cracks and fissures in the fuel bed, not through the bed itself, as is generally claimed. If it were possible to maintain a fuel bed free from fissures on an underfeed stoker, the result would be low efficiency, due to the fact that it is impossible to force enough air through a bed of this kind to completely burn the fuel. The action would be, in fact, very similar to that of a gas producer. The chain grate, on the other hand, operates in such a way that by far the greater part of the air supply is admitted at the rear of the grate, the place where the least is required. The underfeed possesses the decided advantage of high capacity, but cannot be depended upon for uniform fuel-bed conditions and refuse disposal; the chain grate provides uniform fuel bed and ready disposal of refuse but is not suitable for high coal burning rates.

An analysis of the chemistry of coal burning will help to arrive at a better understanding of the requirements of an efficient stoker from the viewpoint of the chemistry involved. There is nothing mysterious about the chemistry of combustion, but it is also true that the process is not so simple that it can be readily understood without some study. The few chemical terms and symbols employed in the explanation of the phenomena involved soon became familiar with use. While it is true that the composition of coal itself is a complex mixture and the arrangement of the elements composing this mixture is still unknown to the chemists, it is a fortunate circumstance that this knowledge is not essential to an understanding of the action which takes place when coal is heated to high temperature in the presence of air.

There are but three chemical elements with which we are greatly concerned in the study of coal combustion. Two of these are the principal constituents of the coal and the other is one of the two main components of air. The sources of heat in coal are carbon, represented by the symbol C and the hydrogen, H. Coal also contains oxygen, O, nitrogen, N, and sulphur, S, but these elements are present in relatively small quantities and furthermore are to a great extent inactive. The oxygen of the air is the third element.

When carbon is burned in air, the product first formed is the gas carbon monoxide, CO. With a sufficient air supply, the carbon monoxide burns to carbon dioxide, CO_2, also a gas. In burning to carbon monoxide, 4400 B.t.u. of heat are produced from each pound of carbon, but if the combustion is complete and carbon dioxide is formed, 14,500 B.t.u. are available from each pound of carbon. It is obvious, therefore, that complete combustion is essential. When hydrogen is burned it forms but one compound—water. The heat produced, however, is not all available in boiler practice, for the water formed leaves the boiler as a gas and we lose what is called by the scientist the "latent heat of vaporization"—that is, the heat required to turn water at its boiling point into steam at the same temperature. Hydrogen burned to gas generates 52,000 B.t.u. per pound. Here again it is apparent that complete combustion is necessary, for the heat value is high and losses due to comparatively

small quantities of unburned hydrogen in the flue gases will have an appreciable effect on the efficiency.

The combustion of coal always proceeds in three stages, whatever the means employed. First, the coal is subjected to high temperatures which break down the structure and drive off the so-called volatile matter, consisting of a complex mixture of tarry matter, water vapor and gases. The residue is coke, a mixture of carbon and mineral matter. This process is known as "destructive distillation" to the chemist; coking to the industry. Secondly, the tars are distilled, subjected to further heat from the furnace and the combination of the gas which is formed by coking, and eventually break down into simpler gaseous compounds consisting principally of carbon and hydrogen. Meanwhile, the carbon of the coke becomes ignited. All of the reaction so far has taken place on the grate or very close to the fuel bed surface. In the third stage the gases formed from the tars and the coke are more or less completely consumed, the one in the furnace above the grate and the other on the grate, and in this last stage occur the losses which lead to low furnace efficiency.

In Technical Paper No. 195 of the Bureau of Mines, "The Tars Distilled from Bituminous Coal in Hand-Fired Furnaces," S. H. Katz has reported some data which is of much interest in connection with the study of what occurs as the coal passes into the coking zone of the furnace. Mr. Katz summarizes the results of his researches as follows:

"When coal is added to fires in uniform quantities and at short, regular intervals, the greatest quantity of tar in the gases is at the surface of the bed.

"At a point 1 ft. above the bed of bituminous coal burning in a large hot furnace at moderately rapid rates, practically all tar had disappeared.

"Naphthalene and anthracene, which, at intermediate temperatures, are characteristic of the thermal decomposition of the primary volatile matter of coal, were absent from the tars collected.

"It is probable that, at the high temperatures of the flames, the tars that escape burning are decomposed directly to soot and fixed gases—that is, without formation of hydrocarbons such as naphthalene and anthracene, which are produced as intermediates, at least in part, at lower temperatures.

"Decomposition of all unburned tars in hot fires to soot and fixed gases occurs in less than 0.1 second."

A combination of the best features of the chain grate and the underfeed types of stokers will retain the flexibility of operation and refuse disposal features of the chain grate and to this add the high fuel burning rate of the underfeed. The operation must be such that the condition of the fuel bed will automatically regulate the distribution of air supply.

The use of mechanical draft, whether forced or induced, requires the expenditure of mechanical power. This power, when subtracted from the energy produced by the boiler, obviously reduces the boiler efficiency or, rather, the over-all efficiency. But the use of mechanical draft enables rates of combustion to be obtained that would otherwise be unfeasible without introducing difficulties due to air infiltration at the lower ratings and due to atmospheric conditions.

It would seem, therefore, that the ideal stoker should be one that is able to operate under natural draft up to combustion rates of, say, 150%, and that above these rates functions with forced, induced or forced-induced draft, as the case may be. In this way high efficiency over-all is obtained at the lower ratings and the higher rates of evaporation can still be obtained by mechanical draft without jeopardizing the efficiency of performance at the lower rates of evaporation.

Recently a standard chain-grate has been equipped with an ingenious set of retarding elements and air baffles arranged for forced draft operation which permit the taking advantage of the principles stated above. Coke burns much more slowly than the gases and it becomes necessary therefore to allow the coke to remain in the furnace for a considerable time after the gases are distilled off. With the chain-grate this is easily accomplished by making the grate of such length that comparatively wide ranges in speed of travel will afford the necessary adjustment. But from the time that ignition of the coke takes place the process of combustion tends to open up the fuel bed and thin it until an excessive air supply is admitted where it will not only be useless as far as combustion is concerned, but harmful because of the reduction in furnace temperature. In order to overcome this objectionable feature, the underfeed principle finds application, the grate being equipped with retarding elements which hold back the coke and thicken the fuel bed, thus permitting the use of forced draft to increase the air supply through the forward end of the grate where the gases are being distilled. As the thick bed of coke approaches the bridge-wall it is gradually consumed and provides a pre-heating element for the excess air required to insure the complete combustion of the relatively small amount of gas which is not consumed close to the fuel-bed. At the forward end of the grate, tars and gases are distilled off when they are mixed with air drawn through the fuel. Before this mixture has traveled far, the tars are broken up and the resulting mixture of hot gases, soot and air is well along the road to complete combustion before it enters the so-called gas-burning zone. At the same time, air which is drawn through the bed of incandescent mixture of ash and coke enters the gas-burning zone, insuring a thorough intermixing of the gases and supplying an excess of highly heated oxygen, with the result that combustion of the volatile portion of the coal is complete.

It seems, therefore, that the conditions mentioned above may be readily met by the application of the underfeed principle to the popular chain-grate without the introduction of radical changes in design of the stoker parts, thus avoiding to a large extent the delay incident to the introduction of new and untried principles. In any event, much information will be gained by this practical attempt to apply in a rational manner the chemical engineering features involved in the economical use of fuel.

Those who are in the best position to forecast tell us that high coal prices have come to stay, and labor leaders announce a decided stand against any reduction in the present wage scales. Economy in the use of all materials is therefore imperative and we look forward to a period of considerable improvement in the design and operation of fuelburning equipment. The stoker manufacturer will not only be subjected to the pressure of his competitors' efforts to meet the demand for high capacity, high efficiency apparatus, but will also feel the effect of the impending competition from fuel oil. It is reported one large paper company changed some of its New England plants to oil burning equipment during the war and that other large coal consumers are showing much interest in oil fuel. Reports from England indicate that the oil interests have already gained a strong competitive position.

Chemical and Physical Control of Boiler Operation

Abstract of A. S. M. E. Paper—Included Is the Application of Simple Formulas for Estimating Heat Loss Items, etc.

By E. A. UEHLING

President, Uehling Instrument Company.

THE best method for attaining the conservation of fuel has not been definitely outlined by engineers. There is, therefore, room for discussion, and it is intended to treat the subject in the present paper from the chemical and physical aspects of combustion.

Before intelligent steps can be taken to bring a given boiler plant to its maximum efficiency, it is necessary to know with what efficiency the plant is working. Scientific refinement is not necessary in every-day practice, but scientific reasoning must be applied, and the data upon which reasoning can be based must be observed and, wherever possible, autographically recorded.

Methods of Controlling Boiler-Plant Operation.

The economical status of a boiler plant can be ascertained by either of the two distinct methods, viz.: (a) The mechanical method, based on the heat utilized; (b) the chemical and physical method, based on the heat wasted.

The mechanical method relies on the readings of the coal weigher and the water meter or steam-flow meter. If the heat value of the fuel is known, the data obtained by these appurtenances enable one to calculate roughly what percentage of the heat in the coal fired is utilized in making steam. For obvious reasons the results cannot be calculated oftener than once a day and generally once a week is considered sufficient. Aside from the lateness in obtaining the desired information, this method suffers in accuracy and reliability as a control from the following errors and shortcomings:

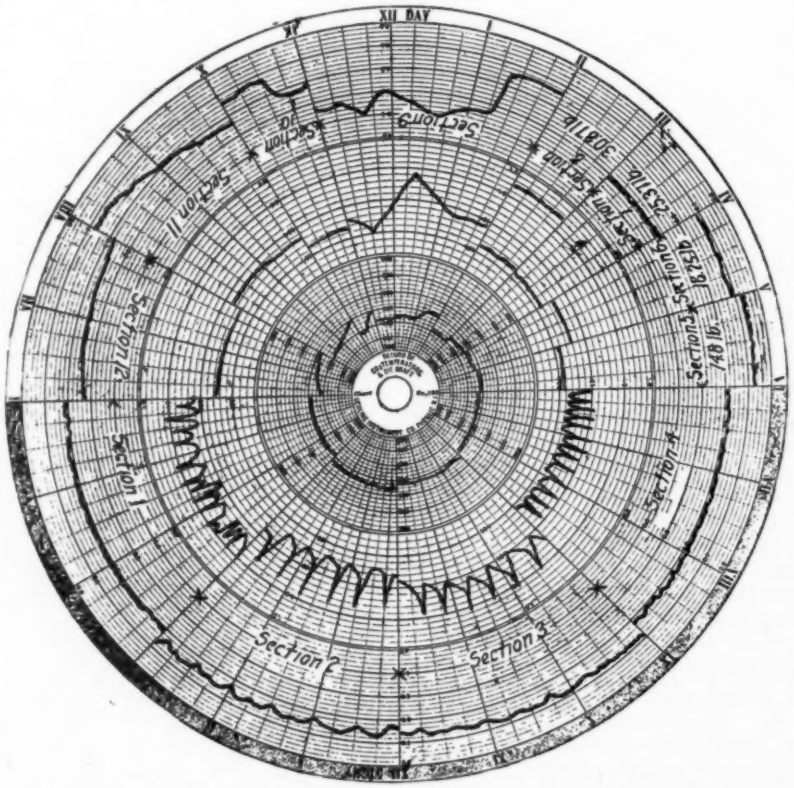
(a) The coal weigher cannot discriminate between coal and ash and moisture, and since these constituents are never constant and frequently vary 5% or more in successive shipments, and since the heat value of the fuel depends on its purity, the calculated results will be that much in error.

(b) The water passed through the meter is not all evaporated. An appreciable amount may be carried over with the steam, more may be lost through leaky blow-off cocks, and considerable is wasted by blowing off the boilers, which is not only not accounted for but actually appears on the credit side.

(c) The steam may be superheated.

(d) The feedwater temperature may vary appreciably.

Thus we see that a water meter and coal weigher can give only a rough, wholesale control, unless supplemented by scientific instruments and observations. The mechanical control has another and even more serious shortcoming in that it gives absolutely no clue as to why the plant as a whole is operating more or less wastefully.



Sections of Charts Recording CO_2, Stack-Gas Temperature and Boiler Draft.

The wholesale chemical and physical method of control is based on the readings of a CO_2 meter and pyrometer inserted in the main gas flue or near the chimney. This method suffers from the following deficiencies and inaccuracies:

(a) The indicated and calculated results are qualitative.

(b) The results do not represent all the heat wasted.

(c) From the CO_2 determination in the chimney gas one is unable to discriminate between excess air through the fire and that leaking through the boiler walls, as well as that leaking into the gas flue between the boilers and the point where the sampling tube must be inserted to get the gas from all the boilers. Air entering beyond the boilers does not militate against efficiency except as it may overburden the chimney and reduce the draft below that required for efficient combustion.

The wholesale chemical and physical method has

the following advantages over the mechanical method:

(a) It can be more easily and cheaply installed.

(b) The records show up the collective operation of the boilers continuously instead of only at the end of longer or shorter periods; one day at best.

(c) It shows up the combustion and absorption efficiency factors separately so that the proper steps to improve the efficiency of the plant can be promptly and intelligently taken.

(d) The value of its records is not affected by a variation in ash or moisture content of coal burned. Nor is the record affected by the waste of feedwater nor the variation in its temperature.

From the preceding consideration it becomes evident that both wholesale methods are equally handicapped as an aid to improve boiler efficiency, and that in order to obtain maximum collective boiler efficiency each boiler must be diagnosed individually. To be under proper economic control, both its combustion and absorption efficiencies must be under constant observation. Maximum boiler efficiency cannot be maintained without *knowing what every boiler is doing all the time*. To this every combustion and boiler expert will agree; but opinions will no doubt differ as to the best means for effecting this constant observation. It would appear obvious that the most direct way is the best way. Combustion is a chemical phenomenon and should therefore be most effectively controlled by chemical means. Absorption is a physical phenomenon and is best controlled by physical means. The two principal instruments of observation are the CO_2 meter, a chemical instrument, and the pyrometer, which is a physical instrument. As a necessary auxiliary the double differential draft gage is required. Boiler draft and furnace draft are essential elements in the proper control of combustion and should be observed separately.

The slogan for the boiler room should be: *Watch your results and change your adjustments to keep the results right.* There is no such thing as a fixed adjustment in the operation of a boiler. The rate of combustion must be changed to keep the steam pressure right, the draft must be changed to keep the rate of combustion right, and the thickness of fire must be changed to keep the efficiency of combustion (per cent of CO_2) right. As the fuel and ash bed thickens, a stronger draft is necessary to keep the required rate of combustion, and there are numerous minor variables which require changes in the draft adjustments if combustion efficiency and the required boiler capacity are to be maintained, *i. e.*, maximum CO_2 and a uniform steam pressure. To insure these results CO_2 as well as boiler and furnace draft indicators must be placed at or near the boiler front within easy view of the fireman and in close proximity to the draft-regulating wheel or lever.

Information Afforded by Recording-Instrument Charts.

The three autographic records, namely, those of CO_2, temperature of the escaping gas and the boiler draft, preferably on one chart, give the engineer in charge the following information at a glance:

(a) Whether normal combustion efficiency has been maintained; and, if not, the precise time when it became abnormal and how long it remained so. This enables him to inquire into the cause, with the confidence born of knowledge, and to apply the proper correction. The continuous record further reveals in hand-fired boilers how often the fires were replenished, how long the fire doors were left open, when the fires were cleaned, and how long it took to clean them. In stoker-fired boilers changes in handling the fire are similarly revealed.

(b) The temperature record shows whether the absorption efficiency has continued normal; if not, the variation may be due to necessary variations in the rate of driving, and if so, this will be revealed by the record of the boiler draft, which is an index to the rate of driving. Or it may be due to a breaking down of the baffling, which is also instantly revealed by the boiler draft. The mucking-up of the heating surface is indicated by a gradual increase in the temperature of the escaping gases.

(c) The record of the boiler draft, in addition to its contributing value to the pyrometer record, becomes in combination with the per cent of CO_2 a very good index to the rate of combustion, as the writer will endeavor to show later.

Examples of Application of Information Given by Charts to Control of Firing.

The illustration shows sections of recording-instrument charts indicating various relations of these three records to each other. The CO_2 records shown in Sections 1 and 2 are facsimile samples of records from a boiler of the Manning type burning No. 1 buckwheat coal. Sec. 1, made when the recorder was first installed, shows that the firing was irregular and that the coal-bed was kept too thin, through which holes quickly developed. The average CO_2 was scant 8%. The reason for the low CO_2 being thus clearly revealed, the proper remedy at once suggested itself. The fireman was instructed to carry a little heavier fire and watch the CO_2 indicator, with the result shown in Sec. 2, which is a sample record for the same boiler after the fireman had been instructed and had learned to be guided by the CO_2 indicator in adjusting the thickness of the fire to the draft necessary to maintain the required steam pressure. So guided he had no difficulty in keeping the CO_2 at an average of about 12%. Having the three principal records on the same chart, their relation to one another is readily perceived, and it will be seen at a glance that the boiler draft is about 0.80 in. higher under the conditions represented by Sec. 1 than those by Sec. 2, also that the temperature shown in Sec. 1 is about 25° higher than in Sec. 2.

It will be noticed that the gases left the boiler at a temperature 25° higher when containing 8% of CO_2 than when they contained 12%, which shows that absorption efficiency increases with combustion efficiency.

It will further be noticed that the boiler draft is about 0.12 in. with 12% of CO_2 and fully 0.20 in. when only 8% of CO_2 is present, which is due to the greater volume of gas per pound of carbon consumed.

Now since the boiler draft is an approximate index to the volume of gas produced per pound of carbon burned and CO_2 is a true index of the weight of carbon contained in this volume of gas, it follows that if we multiply the boiler draft by the percentage of CO_2, the product will be an approximate index to the rate of combustion. We therefore find that the indices to the rate of combustion under the conditions which are recorded in Secs. 1 and 2 were, respectively, $8 \times 0.20 = 1.60$, and $12 \times 0.12 = 1.44$.

This means that it was necessary to burn about $[(1.60 - 1.44)/1.44] \times 100 = 11\%$ more coal to keep up the steam with 8% of CO_2 than with 12%, which corresponds very well with the improved results attained in the plant in which the records thus analyzed were produced.

Secs. 3 and 4 of the illustration show records representing a water-tube boiler burning bituminous coal. Sec. 3 illustrates conditions before, and Sec. 4, after, control by aid of CO_2. A glance at the CO_2 record will show that the fires carried were too thick. The low percentage of CO_2 (about 8.75%) was due principally to air filtration, but to a considerable degree also to uneven firing producing high CO with low CO_2. Stopping up the air leaks and modifying the method of firing as illustrated by the record and using

the CO_2 indicator as a guide, the fireman had no difficulty in maintaining an average of over 13% of CO_2 with practically no CO.

Contrary to what was seen in Secs. 1 and 2 of the chart, both the temperature of the escaping gases and the boiler draft were higher when the conditions had been changed so as to result in the higher percentage of CO_2. This may at first seem contradictory, but a little study reveals the fact that both the boiler draft and the temperature of the escaping gases were rendered abnormally low by the flow of air (counter draft) entering through the leaky setting. It is therefore necessary to make sure that the setting is made tight before these two factors can be relied upon as indices, respectively, of absorption efficiency and rate of combustion. Furthermore, a low stack temperature cannot be relied on as an index to the former unless the gases contain a high percentage of CO_2.

In Secs. 5, 6, 7 and 8 of the chart are recorded the averages of four 24-hour tests of a large water-tube boiler burning bituminous coal fired by Roney stokers. The coal was burned at four different rates of combustion, viz., 16.7, 18.25, 25.3 and 30.8 lb. per sq. ft. of grate surface per hour. The CO_2 averaged 14.68, 13.05, 14.28 and 14.69%; the boiler draft was 0.08, 0.12, 0.31 and 0.61 in. of water, and the temperature of the escaping gases averaged 483, 542, 662 and 636° F., respectively. The efficiency attained was, respectively, 81.15, 77.45, 75.28 and 76.73%.

These four tests demonstrate that the percentage of CO_2 can be maintained at its maximum irrespective of the rate of driving without increasing the percentage of CO, provided there is ample space for combustion. A large combustion chamber is a most vital factor in securing combustion efficiency.

Sec. 9 of the chart illustrates the relation the three records will take to each other if the demand for steam suddenly increases and the draft is adjusted to increase the rate of combustion to meet this increased demand, but the stoker is not speeded up sufficiently to supply the coal required. The flue gas temperature will at once go up in response to the increased rate of combustion. The CO_2 will soon begin to drop, and if there is no CO_2 indicator to show what is happening it will continue to drop until the fireman discovers that the grate is getting bare and the stoker speed must be increased. He does so, but gives it a little too much speed and the CO_2 goes above the safe limit. If he is a good fireman he will no doubt discover that also and finally get the right adjustment. Meanwhile, considerable fuel has been wasted, first by excess air and then by incomplete combustion. With a CO_2 indicator to guide him this would not have happened.

Sec. 10 illustrates how the boiler-draft and pyrometer records will at once reveal the sudden breaking-down of a section of baffling. Sec. 11 shows how the average temperature and boiler draft would be affected if the baffling disintegrated gradually, and Sec. 12 indicates how the records would be likely to change if the boiler tubes were allowed to muck up gradually. These suppositious cases are given to show how the boiler draft and exit temperatures are affected by the same cause. Neither can be correctly interpreted without the other. Within practical limits of driving the maximum percentage of CO_2 can and should be maintained, whereas both the boiler draft and the exit temperature increase with the rate of driving. The exit gas temperatures vary from the normal from four distinct causes:

(a) Rate of driving.
(b) Defective baffling.
(c) Dirty heating surface.
(d) Air infiltration.

The record of the boiler draft at once reveals the true cause; the pyrometer simply reveals the fact. Low exit gas temperature is generally taken to indicate absorption efficiency and the CO_2 record shows whether it is or not.

It thus appears that the three records, viz., percentage of CO_2, temperature of the escaping gases, and the boiler draft, autographically recorded, preferably on the same chart, reveal in detail all the facts necessary for effective control of the boiler operation. They give a continuous up-to-the-minute history of the essential factors on which economic operation depends and provide a ready means for interpreting the causes of irregularities and for applying the proper remedy promptly and intelligently. The three records being on the same chart, they can be quickly integrated by a polar planimeter and averaged, and thus form the best basis for a bonus system.

In addition to the three recording instruments, an Orsat apparatus is also essential—

(a) For determining the maximum per cent of CO_2 that can be carried without danger of an appreciable loss because of incomplete combustion.
(b) To diagnose the boilers for air infiltration at regular intervals, or in between, if deemed necessary, and
(c) To check up the CO_2 meters when their indications give cause for suspecting their accuracy.

An Orsat is by itself quite inadequate as a control for the firing operations of a boiler plant, even when supplemented by sampling tanks, which combination, although better than nothing, cannot be considered more than a makeshift.

Formulas for Calculating Heat Losses in Chimney Gases.

It will now be shown how the information given by recording-instrument charts may be applied in computing the heat losses in detail. The following simple formulas,[1] developed by the author, are based on a weight of fuel containing 1 lb. of carbon instead of on 1 lb. of fuel or combustible:

$$A_a = \frac{A_c \times 21}{P} - A_c \quad \ldots\ldots(1)$$

$$A_t = \frac{A_c \times 21}{P} = \frac{11.6 \times 21}{P} = \frac{243.6}{P} \quad \ldots\ldots(2)$$

$$L_d = (1 + A_t) S \times (T - t) \quad \ldots\ldots(3)$$

$$L_d = \left(0.24 + \frac{58.46}{P}\right) \times (T - t) \quad \ldots\ldots(4)$$

$$A_a = \frac{A_c \times 21}{P} - (A_c + N_h \times H_a) \quad \ldots\ldots(5)$$

$$L_d = \left(1 + \frac{58 + 46}{P}\right) \times (T - t) \quad \ldots\ldots(6)$$

$$L_c = 10{,}150 \times \frac{P_c}{P + P_c} \quad \ldots\ldots(7)$$

$$L_h = (8734 \times H_a) + (4.3 \times H_a)(T - t) \quad \ldots(8)$$

$$L_v = A_v \left(\frac{117}{P} + 3.8 H_a\right) \times (T - t) \quad \ldots(9)$$

$$P_c = \frac{2100}{P(1 + 3 H_a)} - \frac{(1 + 238 H_a)}{1 + 3 H_a} \quad \ldots\ldots(10)$$

[1] The derivations of these formulae are presented in the complete paper.

$$P_o = 21 - (1 + 2.38\,H_a) \times P \quad \ldots\ldots\ldots (11)$$

$$P_m = \frac{A_c \times 21}{A_c + N_h \times H_a} = \frac{152 \times 21}{152 + 361\,H_a} = \frac{21}{1 + 2.38\,H_a} \quad \ldots\ldots\ldots (12)$$

Where

O = weight of oxygen per lb. of carbon in the fuel.
H_t = weight of hydrogen per lb. of carbon in the fuel.
$H_a = H_t - \frac{O}{8}$ = weight of available hydrogen per lb. of carbon in the fuel.
A_c = weight of air required to burn 1 lb. of carbon.
A_t = total weight of air supplied.
A_e = weight of excess air supplied.
N_h = weight of nitrogen in weight of air required to burn 1 lb. of hydrogen.
A_v = weight of water vapor per lb. of air supplied per lb. of carbon burned.
P = per cent of CO_2 in flue gas.
P_c = per cent of CO in flue gas.
P_e = per cent of excess air in flue gas.
P_o = per cent of free oxygen in flue gas.
P_m = maximum theoretical per cent of CO_2 obtainable from any given fuel.
S = 0.24 = specific heat of dry gases.
T = temperature of gases on leaving the boilers, ° F.
t = temperatures of air supplied for combustion, °F.
L_d = B.t.u. carried off by dry gas per lb. of carbon burned.
L_c = heat value of CO contained in gas per lb. of carbon burned.
L_h = B.t.u. carried off by H_2O produced by the combustion of the available hydrogen per lb. of carbon burned.
L_v = B.t.u. carried off by water vapor in the air supplied to burn 1 lb. of carbon.

Air contains—	% by weight.	% by volume.
Oxygen	23	21
Nitrogen	77	79

One cu. ft. of air at 62° F. weighs 0.0761 lb.
One cu. ft. of nitrogen at 62° F. weighs 0.0742 lb.

Application of Formulas to Data Derived from Autographic Records of CO_2.

The usefulness and reliability of these formulas are best shown by applying them to the data observed in a few authoritative boiler tests and comparing the results.

Tests A and B, Table 1, were made on a large boiler of the Stirling type rated at 2400 hp., equipped with forced draft and Roney stokers; the fuel was Pittsburgh coal. Tests C and D were made on a 210-hp. Heine boiler, hand-fired. The fuel was No. 1 Arkansas briquets in test C, and Illinois No. 3 coal in test D.

Dividing the weight of all the constituents of the coal by the weight of carbon per pound of fuel in order to reduce them to the carbon unit basis of 1 lb. gives the following values:

C	H	O	Ash	Moisture	B.t.u.
1.0	0.0683	0.1068	0.0925	0.023	17,984

The available hydrogen per pound of carbon is

$$0.0683 - \frac{0.1068}{8} = 0.055 \text{ lb.} = H_a.$$

Table I.—Data and Results Obtained in Four Authoritative Boiler Tests.

Test. data.	Test A.	Test B.	Test C.	Test D.
Analysis of Coal:				
Carbon, %	76.87	.....	79.76	71.52
Hydrogen, %	5.31	.....	3.91	4.53
Oxygen, %	8.32	.....	2.70	8.18
Nitrogen, %	1.11	.....	1.58	1.52
Sulphur, %	1.20	.....	1.75	1.64
Ash, %	7.19	.....	11.04	15.70
Moisture, %	1.80	.....	0.94	8.51
B.t.u.	13,826	.....	13,885	12,857
Analysis of Gas:				
CO_2, %	14.90	14.23	9.36	7.10
CO, %	0.23	0.36	0.00	0.04
O, %	3.40	4.30	10.57	13.40
Temperature of gas, T, °F.	483	670	624	635
Temperature of atmosphere, t, ° F.	73	81	87	62
Total effective draft, in. of water	0.26	0.57	0.35	0.58
Furnace draft, in. of water	0.14	0.22	0.15	0.21
Boiler draft, in. of water	0.12	0.35	0.20	0.37
Humidity in air, % saturation	62.4	64.5	.....	.....
Carbon in ash, %	31.6	38.0	23.02	23.73
Duration of test, hours	24	30	10	10
Rated hp. of boilers	2400	2400	210	210
Test Results as Reported.				
Efficiency, %	81.15	75.78	67.33	64.20
Heat loss up chimney, %	15.15	19.76	23.12	32.60
Heat loss in ash, %	2.29	2.13	.....	.....
Heat loss by radiation, etc., %	1.51	2.33	9.55	3.74
Total	100.00	100.00	100.00	100.00
Water evaporated per lb. of coal, lb.	9.95	9.01	7.9	6.2
Coal burned per hr. per sq. ft. of grate, lb.	14.81	25.97	18.74	21.23
Hp. developed	2225	3606	206	201
Driving, % of rating	94	152	98.3	95.5

The water of hydration per pound of carbon is

$$0.1068 + \frac{0.1068}{8} = 0.12 \text{ lb.} = W_{hy}.$$

From the data obtained in Test A, the heat carried up the chimney by the dry gases, according to Formula (3), is

$$L_d = \left(0.24 + \frac{58.46}{P}\right) \times (T - t).$$

Substituting the values of P, T and t,

$$L_d = \left(0.24 + \frac{58.46}{14.91}\right) \times (483 - 73) = 1706 \text{ B.t.u.}$$

Also, the heat value of the CO_2 contained in the gas, according to Formula (7), is

$$L_c = 10{,}150 \times \frac{P_c}{P + P_c}.$$

Substituting the values of P_c and P,

$$L_c = 10{,}150 \times \frac{0.023}{14.9 + 0.23} = 10{,}150 \times 0.0151 = 153 \text{ B.t.u.}$$

From Formula (8) the heat carried off by the H_2O from the combustion of the available hydrogen is

$$L_h = 8734\,H_a + 4.32\,H_a\,(T - t).$$

Substituting the values of H_a, T and t,

$$L_h = 8734 \times 0.055 + (4.32 \times 0.055 \times 410) = 578 \text{ B.t.u.}$$

Also, the heat absorbed by the humidity in the air, according to Formula (9), is

$$L_v = A_v \left(\frac{117}{P} + 3.8\, H_a \right) \times (T - t).$$

The average temperature of the air during the test was 73° and the average humidity 62.4% saturation. At this temperature and saturation the water vapor carried into the furnace is 0.0106 lb. per lb. of air supplied $= A_v$. Substituting this value and the values of H_a, P and $(T - t)$ in Formula (9),

$$L_v = 0.0106 \left(\frac{117}{14.90} + 3.8 \times 0.055 \right) \times 410 = 34 \text{ B.t.u.}$$

The heat carried by the water of hydration equals

$$L_w = W_{hy} \times (0.48\, T + 1080 - t).$$

Substituting the values of W_{hy}, T and t,

$$L_w = 0.12\ (0.48 \times 483 + 1080 - 73) = 149 \text{ B.t.u.}$$

Substituting the value of W_m for W_{hy}, where W_m is the weight of moisture per lb. of carbon, the loss due to the moisture in the coal is

$$L_w = 0.023\ (0.48 - T \times 483 + 1080 - 73) = 28 \text{ B.t.u.}$$

The foregoing comprise all the items of heat wasted up the chimney with the exception of that contained in the hydrocarbons, if any, and in the soot and ash passing off with the gases, and may be enumated as follows:

Heat-Loss Items Up the Chimney.

	B.t.u.
(a) Heat carried to waste by the dry gases	1706
(b) Heat value of CO	153
(c) Heat carried to waste by the H_2O from the combustion of the available hydrogen	578
(d) Heat loss due to the humidity in air	34
(e) Heat carried to waste by the water of hydration	149
(f) Heat carried to waste by the moisture in the coal	28
(g) Total heat in H_2O in gases	789
(h) Total heat in flue gas per lb. of carbon burned (items a, b and g)	2648

Hence $\frac{2648 \times 100}{17{,}984} = 14.72\%$ of the heat of the coal remained in the gases as they left the boiler.

The ash contained 31.6% of carbon and since the coal contained 0.0925 lb. of ash per lb. of carbon, the loss due to the heat value of the combustible in the ash is

$$0.316 \times 0.0925 \times 14{,}600 = 427 \text{ B.t.u.}$$

which represents

$$\frac{427 \times 100}{17{,}984} = 2.38\% \text{ of the heat in the coal.}$$

The total heat loss accounted for by the preceding calculations is therefore

	Per Cent.
Heat absorbed by boiler	81.10
Heat loss up the chimney	14.72
Heat loss through the grate	2.38
Heat loss from radiation, etc.	1.80
Total	100.00

The heat-loss items in Test A were reported as follows:

	Per Cent.
Moisture in coal	0.16
Hydrogen in coal	4.29
Heat to chimney	9.11
Moisture in air	0.20
Carbon monoxide	1.29
Carbon in ash	2.29
Total losses accounted for	17.34
Absorbed by boiler	81.15
Radiation, etc.	1.51
Total	100.00

Applying the same formulas to the observed data of Tests B, C and D, the results given in Table 2 are obtained.

Combustion efficiency in the operation of a boiler means only that all the combustible in the fuel must be completely oxidized, but that it must be oxidized in a manner that the maximum amount of the heat liberated becomes available to the boiler. Theoretically, all the heat liberated by combustion is available to the boiler except that contained in the gases below the temperature of the water in the boiler and the latent heat of the H_2O contained in the gases. Hence, combustion efficiency so far as it is under the control of the fireman $= \frac{\text{Available heat liberated}}{\text{Heat available in fuel}}$.

Analyzing the results of these heat-loss calculations it is found that in Test A, $1706 \times 100/2648 = 64.12\%$ of the heat up the chimney is carried by the dry gases, and that the heat value of the CO amounts to $153 \times 100/2648 = 5.78\%$. The remainder, or 30.1%, is carried off by the H_2O from coal and air.

Table 2.—Results of Application of Formulas to Data of Tests B, C and D.

	Test B.	Test C.	Test D.
(a) Heat carried to waste by dry gases, B.t.u.	2560	3480	4853
(b) Heat value of CO contained in gases, B.t.u.	251	0	57
(c) Heat in H_2O from combustion of available hydrogen, B.t.u.	610	497	549
(d) Heat loss due to humidity in air, B.t.u.	72	.....	.....
(e) Heat carried to waste by water of hydration, B.t.u.	153	36	164
(f) Heat carried to waste by moisture in coal, B.t.u.	29	15	154
(g) Total heat in H_2O in gas, B.t.u.	864	548	867
(k) Total heat in flue gas per lb. of carbon burned, B.t.u.	3675	4028	5777
Heat of coal remaining in gases leaving boilers, %	20.43	23.17	32.14
Heat loss due to combustible in ash: B.t.u.	416	429	867
% of coal	2.31	2.47	4.82
Total Heat Loss:			
Heat absorbed by boiler, %	75.78	65.39	60.32
Heat loss up the chimney, %	20.43	23.17	32.14
Heat loss in range grates, %	2.31	2.47	4.82
Heat loss from radiation, etc., %	1.48	8.97	2.65
Total	100.00	100.00	100.00
Losses in Test Report:			
Moisture in coal, %	0.17	.....	.....
Hydrogen in coal, %	4.49	.....	.....
Heat to chimney, %	12.79	.....	.....
Moisture in air, %	0.36	.....	.....
Carbon monoxide, %	1.95	.....	.....
Carbon in ash, %	2.13	.....	.....
Total loss accounted for, %	21.89	.....	.....
Heat absorbed by boiler, %	75.78	.....	.....
Heat lost in radiation, etc., %	2.33	.....	.....
Total	100.00	.....	.....
Heat Balance in Test Report:		%	%
Heat absorbed by boiler (= evaporation from and at 212° per lb. of combustible)	.....	62.33	64.20
Loss due to moisture in coal (= % of moisture referred to combustible)	.....	0.09	0.96
Loss due to moisture formed by burning of hydrogen (= % of hydrogen referred to combustible)	.....	3.28	4.18
Loss due to heat carried away by dry chimney gases (= weight of gas per lb. of combustible)	.....	19.75	26.60

Loss due to unconsumed hydrogen, heating of moisture and unaccounted for	9.55	3.74
Loss due to incomplete combustion of carbon		0.32
Total	100.00	100.00

TABLE 3.—ANALYSIS OF HEAT ESCAPING UP THE CHIMNEY.

	Test A.	Test B.	Test C.	Test D.
(1) Per cent of heat up the chimney contained in the dry gas	65.20	69.66	86.40	84.02
(2) Per cent of heat escaping up the chimney represented by CO	5.80	6.83	0.00	0.98
(3) Per cent of heat escaping up the chimney due to H_2O	29.00	23.51	13.60	15.00
(4) Per cent of heat controllable in item (1)	27.00	48.43	69.40	78.26
(5) Per cent of heat controllable in item (2)	100.00	100.00	100.00	100.00
(6) Per cent of heat controllable in item (3)	8.50	7.80	11.20	7.50
(7) Per cent of controllable heat residing in the dry gas	85.20	94.90	97.40	98.70
(8) Per cent of excess air	23.00	29.00	97.00	160.00
(9) Per cent of free oxygen in gas.	4.16	4.83	10.57	13.10

Since the gases cannot be cooled below the temperature of the water in the boiler, it is evident that only the heat contained in the gases above that temperature is under control of the boiler operation.

Applying Formula (12) it is found that the theoretical maximum percentage of CO_2 obtainable from the coal used in Test A is

$$P_m = \frac{21}{1 + (2.38 \times 0.055)} = 18.57.$$

The temperature of the water in the boiler corresponding to the average steam pressure carried during Test A was 384.6° F. Applying Formula (4), the uncontrollable heat in the dry gases per pound of carbon burned is found to be

$$L_u = 0.24 + \frac{58.46}{18.57} \times 384.6 = 1246 \text{ B.t.u.}$$

or $$\frac{(1706 - 1246) \times 100}{1706} = 27\%$$

hence only 27% of the heat in the dry gases in this test was controllable.

The loss due to CO is independent of the stack temperature, and since the percentage of CO in the gas can be reduced to zero, the heat loss due to its presence is 100% controllable.

Since the heat loss due to the H_2O in the gases is independent of the CO_2, only that portion is controllable which is affected by the temperature of the flue gas above that of the water in the boiler.

The latent heat of evaporation is not controllable, hence the terms of the formula representing it must also be eliminated. Thus, applying the modified formula to the observed data we have for the controllable heat in H_2O:

$$\left[4.32 \times 0.055 + 0.0106 \times \left(\frac{117}{14.9} + 3.84 \times 0.055\right)\right] \times (583 - 385) + 0.48 \times (583 - 385) \times 0.143 = 67.53 \text{ B.t.u.}$$

Since the total heat carried to waste by the H_2O in the gas is 798 B.t.u., it is seen that only $\frac{67.53 \times 100}{798} =$ 8.5% of it is controllable.

Of the heat in the dry gas $(1706 - 1246) = 460$ B.t.u. were controllable, hence the total controllable heat escaping amounts to $460 + 67.5 = 527.5$ B.t.u., and of this $\frac{460 \times 100}{527.5} = 87.2\%$ resides in the dry gases.

Table 3 gives the results of the foregoing calculations for the four tests under consideration. Item (1) shows what percentage of the heat wasted up the chimney is contained in the dry gas that can be controlled to a greater or lesser degree by improving operating conditions. Item (7) shows what percentage of the controllable heat resides in the dry gases. All of which emphasizes the importance of the CO_2 and temperature records, as controlling factors in boiler operations.

The fireman must drive his boilers in accordance with the demand for steam. He has no control over the condition of the heating surface of his boilers. And since the temperature of the escaping gases depends primarily on one or both of these conditions it is not fair to him to judge his proficiency by heat wasted up the chimney, and much less fair is it to judge him on the basis of pounds of water evaporated per pound of coal burned. In Test A, for example, there was 10% more water evaporated than in Test B, while the difference in furnace efficiency based on heat available was only 2.4%, as demonstrated above.

The proper basis upon which to judge the proficiency of a fireman is the factor $0.24 + \frac{58.46}{P}$ after the maximum percentage of CO_2 (P) with practically complete combustion has been established for the prevailing conditions at any given plant.

Within proper limits of CO_2 there exists no relation between the percentages of CO_2 and CO. Test B, for example, shows 0.7% less CO_2 and 0.13% more CO. Furthermore, it must be borne in mind that the loss due to the same percentage of CO diminishes directly as the percentage of CO_2 increases, as is shown by the factor $\frac{P_c}{P + P_c}$. It is a matter of easy calculation to determine where the loss due to a definite increase in CO will overbalance the gain from an increase in CO_2 making the CO probable.

Assuming, for example, that under the furnace and fuel conditions existing when Tests A and B were made 14% was the safe limit for CO_2 for complete combustion, how much CO will it take to overbalance the benefit of raising the CO_2 to 16%, assuming $T - t = 450°$?

Applying Formula (4), it is found that there is a gain of $\left[\left(0.24 + \frac{58.46}{14}\right) - \left(0.24 + \frac{58.46}{16}\right)\right] \times 450 = 234$ B.t.u., and Formula (7) shows that this gain would be overbalanced by $10{,}150 \times \frac{P_c}{16 + P_c} =$ 234, from which $P_c = 0.38\%$. Therefore, if the increase of CO_2 from 14 to 16% cannot be accomplished without at the same time increasing the percentage of CO by 0.38%, there is no gain in heat to the boiler.

But since there is no definite relation between the percentage of CO_2 and CO, it follows that within proper limits, depending on the construction of furnace, method of stoking, kind of fuel, air control, etc., maximum CO_2 can be attained without appreciable amounts of CO if the fireman exercises proper care and judgment. What these limits are must be ascer-

tained by experiment for each plant, and if the construction of furnace and method of stoking vary appreciably it may be necessary to determine the maximum economic percentage of CO_2 for each boiler. But such determination is of small avail unless the firemen are properly instructed how to get maximum CO_2 with a negligible percentage of CO and have continuously brought to their attention the percentage of CO_2 they are getting.

ELECTRIC ARC WELDING.

British Institution of Civil Engineers Discusses Three Papers by Experts.

Electric welding has been the leading subject of interest at meetings of the English engineering institutions since the signing of the armistice. Mechanical, civil and electrical meetings in London have discussed it, while gatherings of similar organizations in the provincial centers have also been expressly devoted to it. The Institution of Civil Engineers in London devoted its sitting of March 11 to the consideration of three papers as follows:

1. "Electric Welding Developments in Great Britain and the United States of America," by J. Caldwell and H. B. Sayers.

2. "Experiments on the Application of Electric Welding to Large Structures," by W. S. Abell.

3. "The Application of Electric Welding in Ship Construction and Repairs," by J. R. Smith.

In the first of these papers the authors attributed the retarded expansion of electric welding in the past chiefly to the absence of clear understanding as to the essentials of the process, also to the lack of facilities to enable research investigation to be undertaken. Special skill was stated to be required in manipulating with the carbon-arc process, by reason of the great heat generated at the arc. Welding by this means had therefore been largely confined to work of substantial size and thickness, but by observing certain necessary precautions, success had been achieved in applying the process to work of a general nature, particularly where speed was important. The authors cited instances of the efficiency and economy resulting from the use of electric welding in steam railway practice and gave data regarding repairs. The metal electrode process is utilized almost entirely on this type of work and with the recent improvements in England of the flux-covered electrodes, some of which are specially designed for welding high tensile and alloy steels, the scope for electric welding plant in railway shops should be increased. Messrs. Caldwell and Sayers said that electric welding should benefit the automobile industry, especially in the easy assembly of steel bodies and in the repair of special steel parts with composite metal electrodes covered with suitable composition, by which means alloy and high-tensile steel can be successfully repaired and reinforced with metal having characteristics allied to those of the original material. Gear wheels and gear cases can be renovated, tanks and barrels manufactured, and caulking eliminated in riveted structures. In shipbuilding electric arc welding had been proved practical as a substitute for forging, riveting and caulking. Following the satisfactory conclusion of a series of tests, certain ship structures had been assembled either entirely or in part by this means and the authors gave examples where the process may be used to advantage in the construction of internal fittings and superstructures. Concerning the possibility of joining ships' hulls with spot welding, information derived from recent experimental work indicated that spot welding of thick steel plates was capable of results equal in strength to riveting, with appreciable economy.

In the second paper (W. S. Abell) a full account was given of the comprehensive series of experiments recently carried out on behalf of Lloyd's Register of Shipping, to determine the possibility of the application of electric arc welding to ship construction.

The third paper (J. R. Smith) contained illustrated descriptions of typical repairs that had been successfully carried out under the author's supervision. Considerable economy in money and time was claimed, inasmuch as the necessity for renewals was obviated. The success of this system had encouraged the idea of substituting it for the present method of rivetting, and in any case marked economy of material would result from eliminating rivets to a large extent if not entirely. The secret of success in electric arc welding was largely in the hands of the operator and careful inspection was essential.

BOOK REVIEW.

"Principles of Combustion in the Steam Boiler Furnace." By Arthur D. Pratt. 1919 Edition. New York: The Babcock & Wilcox Co.

The author, in his introduction of this work, states that the function of a boiler furnace is the generation of the maximum amount of heat from a given quantity of a specific fuel, and if such function is to be properly fulfilled, it is essential that the furnace operator understand the broader principles involved in combustion. He further states that unfortunately from the standpoint of efficient steam generation, the statement is too frequently accepted as true that theoretical generalizations and mathematical formulas are of but little value to the operating engineer. To an extent this may be true, but on the other hand, it is to be remembered that combustion is purely a chemical phenomenon and as such can be properly investigated and controlled only by chemical means. Power-plant owners are more and more appreciating the necessity for intelligence in the boiler room—the reinforcing of experience in firing by a full knowledge of the theory of combustion—and in the growing number of plants where this need is realized suitable apparatus is installed for the determination and checking of combustion results. In plants not so equipped, the possible savings due to the intelligent use of such apparatus and the proper application of the data so obtained in reducing preventable losses, are in the aggregate enormous.

The contents of the book are divided into 13 sections or chapters, as follows: Introduction; The Chemistry of Combustion; Density, Weight and Volume of Gases; Heat of Combustion; Specific Heat; Temperatures Developed in Combustion; Air and Combustion; Combustion Formulas; Combustion Losses; Smoke; General Conclusions; The Computation of Combustion Data, including coal, wood, oil, natural gas, by-product coke oven gas, blast furnace gas; Heat Balance, including solid or liquid fuels and gaseous fuels. Many tables and a number of charts are given to clearly convey the author's ideas.

The book is well gotten up, the style is most pleasing, and the subject matter has been ably handled by one a master of his subject. To those familiar with the principles of combustion in the steam boiler furnace, this book will make interesting reading. For those aiming to master the subject it will be of great help.

Lubrication of Electric Generators and Motors

Importance of Lubrication—Influence of Type of Apparatus upon Choice of Lubricant—Characteristics of Different Lubricants — Choice of Lubricant for Specific Purposes

By REGINALD TRANTSCHOLD

Engineering Department, Swan & Finch Company.

ELECTRICITY, if not the most potent force in industry, is today, without doubt, the most effective, most mobile and most convenient form of power. As a rule, steam-driven equipment is employed to generate electricity. But the mechanical efficiency of the generator, the dynamo, and of the prime mover—the motor—is so high and the transmission and distribution economies of electricity so marked that to convert mechanical energy into electrical and reconvert the electrical into mechanical power has been proved to be, in a surprising number of cases, more economical than to transmit and distribute the mechanical energy, without transformation, through belts or other mechanisms.

Electric generators and motors are mechanically efficient for the reason that their construction from a mechanical point of view is extremely simple. Disregarding the electrical features, they may be likened when in operation to a concentrically weighted shaft supported in what might be termed "virtual suspension" between well aligned and adjacent bearings. The resistance to the rotation of the armature in the magnetic field, in the case of the generator, and the force tending to arrest the rotation of the armature, in the case of the motor, is many times as great as the frictional resistance of the bearings to the armature shaft. In other words, the frictional resistance to the rotation of the armature shaft is little affected by the load on the unit. It is dependent, rather upon the weight of the armature, so that the frictional resistance in an electric generator or motor is little greater at full load than it is under no load. Instead of this peculiarity decreasing the need for lubrication, however, it adds to the importance of proper and adequate lubrication for generator and motor bearings, if the high mechanical efficiencies of such electrical equipment are to be realized and the customary double energy conversion justified from an economic standpoint. The more efficient a mechanism, the more imperative it is that its best attainable efficiency be realized. If waste, which means reduced mechanical efficiency, can ever be countenanced, it should be only in the instance of, relatively, mechanically inefficient mechanisms where a little more or less effectiveness in operation is discounted by the normal inefficiency of the apparatus.

Lubrication of Rotating Electrical Apparatus.

Lubrication of electric generators and motors is highly important and the lubricant employed—usually an oil, though one of the modern scientifically compounded lubricants is nearly always more effective and economical in the long run—must be free from corrosive acids or alkalies, possess as low a coefficient of friction (the index of molecular friction) as is feasible and be as stable as possible—*i. e.*, not liable to chemical change under service conditions. A lubricant to render effective service must possess, in fact, six essential properties:

1. Body, or viscosity, sufficient to prevent contact of bearing surfaces.
2. Freedom from corrosive acids or alkalies.
3. Maximum fluidity consistent with body.
4. Low coefficient of friction.
5. High flash and burning points.
6. Freedom from ingredients liable to cause gumming or oxidation.

Tenacity and durability might be added to the list of essentials for an effective lubricant, particularly for electric generator and motor lubrication, but a lubricant possessing the above six specified properties might render effective lubrication service without being particularly tenacious or durable, if supplied in adequate quantity; or a potentially effective lubricant might not have the required tenacity to cling to the rapidly rotating shaft, though of a quite durable nature.

Obviously, the speed and power of the electric generator or motor must be taken into consideration if a suitable lubricant for a particular service is to be selected upon any logical basis, but it is also quite evident that a distinctive lubricant for each size of unit, etc., is not commercially practical. Some classification of equipment is necessary and about the most that can be expected in actual practice is the selection of a lubricant suitable for some more or less arbitrary class of equipment. For instance, if electric generators and motors be grouped in such classes as extra heavy units, heavy units, medium (ordinary or customary) units and small units and an effective lubricant selected for each class the limit of commercial classified standardization is about realized.

Choice of a Lubricant.

Oil is quite generally the variety of lubricant employed for generator and motor bearing lubrication. In order for the oil to possess the necessary low coefficient of friction and permanency of composition from the point of view of practical cost it should be a mineral oil, a product of crude petroleum. Such oils can be refined to possess the six essential properties of an effective lubricant and marketed at reasonable prices. Furthermore, such oils give good satisfaction in electric generator and motor lubrication service. These particular mineral oil lubricants are commonly termed dynamo motor oils and suitable grades are obtainable for each of the four arbitrary classes established for generator and motor equipment.

For the class of extra heavy units a clear amber oil of high viscosity should be employed. An oil of a specific gravity (Baumé) of 30.5, or thereabouts, and a flash point of 420° F. The fire point should be

some 50° higher and the cold test low, in the neighborhood of 20°. The viscosity of the oil should be close to 200 (Saybolt) at 100° F.

The suitable lubricant for the class of "heavy units" is a pale clear mineral oil of good viscosity, about 180 (Saybolt) at 100° F., and a specific gravity (Baumé) of 31. The flash point does not have to be as high as in the case of the lubricant for "extra heavy units," but still high, 400° F., and the fire point some 50° higher, while the cold test should be low, on account of the heavy service, in the neighborhood of 20° F.

For average electric generators and motors, classified as "medium units," the oil should be clear and of medium viscosity, *i. e.*, about 140 (Saybolt) at 100° F. The flash and fire points should be in the vicinity of 390° and 440° F., respectively, while the specific gravity (Baumé) will run close to 32. The cold test for such an oil will rarely be below 30° F., *i. e.*, the oil will congeal at or slightly below the freezing point for water.

The lubricant for "small units," which are, as a rule, high speed, should be clear pale oil of light viscosity and a specific gravity (Baumé) of between 27 and 28. The Saybolt viscosity of 90 proves most effective in the great majority of cases, while the flash point, fire point and cold test of the oil should be approximately 345°, 395° and 18° F., respectively.

To summarize, the suitable oil lubricants for effective and economical lubrication of electric generators and motors should be high-grade, clear mineral oils conforming with the general specifications incorporated in the following table:

ELECTRIC GENERATOR AND MOTOR OIL LUBRICANTS.

	General Lubricant Specifications.				
Class of Units.	Sp. Grav., Baumé.	Flash, ° F.	Fire, ° F.	Cold test, ° F.	Viscosity, Saybolt.
Extra heavy	30.5	420	470	20	200 at 100
Heavy	31.0	400	450	20	180 at 100
Medium	32.0	390	220	30	140 at 100
Small	27.5	345	395	18	90 at 100

Effective and generally satisfactory as are the foregoing oil lubricants for the lubrication of dynamo and motor bearings, they are not representative of the progress that has been made in the development of scientifically compounded lubricants nor are they as economical and effective in service as certain of the special lubricants that have been evolved. Even the most suitable oil lubricants possess failings. The six essential properties of an effective lubricant can be possessed by any straight mineral oil or blend of such oils in relative and varying degree. To possess the necessary body to prevent contact of bearing surfaces and be of maximum fluidity, they lack the clinging capacity necessary to guard against being slung from the rapidly rotating shafts and being squeezed from the bearings under pressure. The result is that no oil lubricant is entirely free from the dripping, climbing and spattering evils that entail an unnecessarily lavish use of lubricant, tend to produce uncleanly and frequently harmful conditions and endanger the life of the bearing by the possibility of an inadequate supply of lubricant. The desirable property of tenacity with the resulting quality of durability is a characteristic of a grease and is distinct from lubricating efficiency.

Natural greases, which are nothing more than crude petroleum products, are not suitable for effective lubricating service, for they are not sufficiently stable and are readily affected by comparatively slight rises in bearing temperature. Manufactured greases, though possessing the desired tenacity and durability in service, do not make satisfactory electric generator and motor lubricants, for before they can function they have to be reduced to lubricating consistency. That is, before even the best grade of grease can be of any effective service in overcoming friction, a frictional load has to be developed on the bearing to elevate the temperature of the grease sufficiently to reduce it by melting to lubricating consistency. However, the desirable lubricant for electric generator and motor bearing lubrication should possess the tenacious clinging capacity of a high-grade grease, with unusual wearing qualities, but at the same time the desirable lubricant should be of a degree of fluidity (normal) sufficient to allow it to be fed from an ordinary oil can, a fluidity not unlike that of a high-grade, free-flowing machine oil, and capable of functioning with the first turn-over of the armature shaft.

SPECIAL TRAIN FOR WESTERN DELEGATES TO N. E. L. A. CONVENTION.

The Transportation Committee of the National Electric Light Association has completed the transportation arrangements for the victory convention to be held at Atlantic City. It has been decided that in view of the excellent train service that exists between New York and Atlantic City and the short time required (3 hours) to make the trip, no special trains will be arranged for from New York City, but the Transportation Committee will work in close touch with the railroads and arrange as far as possible for the convenience and comfort of the members of the Association making the trip. The New England contingent will be moved in about the same way, going to New York and from there to Atlantic City on such regular trains as suit the convenience of the members, or use can be made of the new Hell Gate Bridge, N. Y., route direct to Philadelphia.

A special train for delegates will be run from Chicago over the Pennsylvania lines. This train will run as a second section to the Manhattan Limited, in accordance with the following schedule:

May 18, 1919—
Leave Chicago ..... 9:45 a. m.
Leave Fort Wayne ..... 1:35 p. m.
Leave Mansfield ..... 6:12 p. m.
Leave Alliance ..... 8:40 p. m.
Leave Pittsburgh ..... 11:14 p. m.
May 19, 1919—
Arrive North Philadelphia ..... 7:34 a. m.
Arrive Atlantic City ..... 9:00 a. m.

Special baggage tags in colors will be prepared and given to all those traveling on the special train only. These will be found a great convenience in the handling of baggage at both starting and destination point. The tags will provide places for the name of the owner and the hotel at which he is going to stay. All reservations for special train must be made through Fred R. Jenkins, master of transportation, 72 West Adams street, Chicago, Ill.

TALLULAH HYDROELECTRIC DEVELOPMENT NEARING 72,000 KW. INSTALLED.

The sixth turbine and generator at the Tallulah station of the Georgia Railway & Power Co. will soon be in service. This unit is a Francis type turbine of 18,000 hp. operating under a 600-ft. head at 514 r.p.m. The generator is rated at 12,000 kw., 6600 volts, 60 cycles, 3-phase. The sixth unit is similar to the other five already in service. The work has been in progress about one year and will have cost, when completed, about $500,000.

LARGE COAL MINE ADOPTS ELECTRIC POWER FOR HAULING.

Description of Recent Electrical Installation at Moffat Bros. Mine.

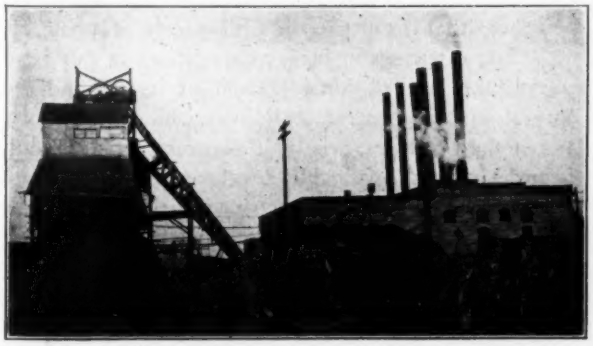
By W. P. Potter.

The use of steam underground has always been costly, as well as dangerous, and the naturally increasing distance between the working forces and the delivery points in coal mines has made necessary the adoption of a system more efficient than steam, compressed air, or mules by many mines. In such cases the installation of improved modern electrical machinery, adapted to the special power requirements of the coal mine, has resulted in a greatly increased output at a much more economical consumption of power. This is especially true of the electric mine locomotive whose superiority for mine haulage has caused it to supplant almost every other means of transportation in coal mines. It is simple, dependable and compact in underground operations, is capable of much greater speed than any other method of transportation and can operate the entire 24 hours of the day.

This method has been adopted by one of the largest and best equipped soft coal mines in southern Illinois, the Moffat Bros. mine at Sparta, Ill. This mine employs an average of 250 men and hoists about 1100 tons of coal daily, the greater part of which finds its way to the St. Louis market, where the company's main office is located in charge of J. D. Moffat. R. D. Moffat is superintendent of the mine in charge of the Sparta office. Although this mine has been in successful operations for years, it only recently replaced mules for main haulage with electric power.

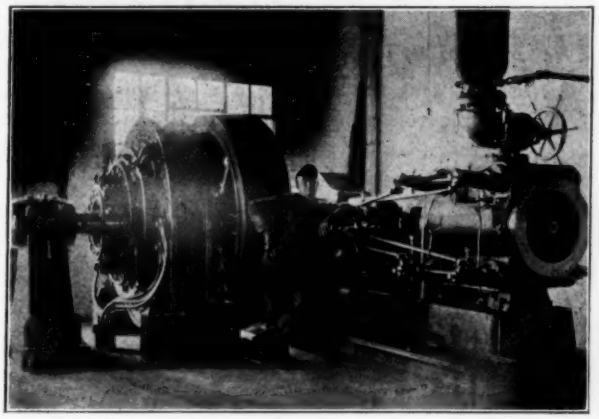
In changing over the motive power of this mine to electric drive 166 tons of steel rails were laid, or nearly 38,000 feet of track for the main haulage. Eleven mules were retained to haul the coal from the different rooms or apartments to the main haulage system, where two 10-ton electric locomotives complete the delivery to the foot of the shaft. These locomotives are equipped with powerful electric searchlights which are essential on main haulage systems to warn of the locomotive's approach and give the motorman an opportunity to stop in case of obstructions.

The mine is so well ventilated by fans that there is very little if any danger from gases, although to a certain extent they are always present. The ventilating doors, practically automatic in operation, easily swing either way at the touch of the motorman's hand, and no trapper boys are necessary when a "trip" of coal is on its way to the hoisting shaft.



Power House and Tipple of Moffat Bros. Mine, Sparta, Ill.

All feeder lines and wiring are installed on porcelain or glass insulators. In the overhead construction of the power wires, the height of the trolley is regulated by extension hangers. The rails on the main line haulage system, which are used as a return circuit, are bonded with a short flexible bond of copper wire securely compressed into holes that are drilled close to the end of the rails to lessen their resistance.



One of the Electric Generators Used to Furnish Power for Moffat Bros.' Coal Mine.

Among the other prominent features of this installation are eight undercutter short wall mining machines and a reliable telephone system. The mining machines have lowered the cost and increased the production of coal considerably and the telephone system materially lessens the work of the operator in supervising the workmen. The coal is loaded by hand.

The electric power is derived from two generators, one of 200 kw. capacity and the other 150 kw. which are direct-connected to steam engines. One of these generators is shown in the accompanying illustration. Two new 150 hp. boilers have recently been added, making six boilers now in use.

STONE & WEBSTER ADVISING NEW YORK RAPID TRANSIT SYSTEMS.

Soon after the Interborough Rapid Transit Co. of New York City passed to a receivership on March 21, by order of the United States District Court, Stone & Webster, of Boston, were retained to analyze its traffic conditions, and this particular work was assigned by that firm to C. W. Kellogg. The Interborough system comprises the principal surface, subway and elevated lines of Manhattan and Bronx boroughs of New York City. Frederick P. Royce, of the Stone & Webster staff, previously was appointed manager for the receiver of the Brooklyn Rapid Transit Co. The entire arrangement places Stone & Webster in a consulting and advisory capacity in all the transportation affairs of Greater New York.

A. L. Kempster, manager of the Seattle division of the Puget Sound Traction, Light & Power Co., prior to the acquisition of its street-car system by the city of Seattle, Wash., has been called to New York City to assist Mr. Kellogg in relation to the affairs of the Interborough system. Mr. Kempster's work will have special reference to the physical element and the operating department. He has had an experience of 20 years in street-car operating in Seattle, having advanced by successive steps as accountant, auditor, trainmaster, superintendent and manager.

Editorial Comment

The Ice Shortage

A MILD winter has made a shortage of ice inevitable this summer. Central stations should interest themselves in this matter as there will undoubtedly be considerable activity in this field. New ice plants are needed and many will be converted from breweries. The ice-making load is one of the most desirable for central stations.

Electric Cooking

THE savings in fuel, food, labor and transportation which were proved for electric cooking during the period of the war should result in considerable activity in this field this summer. Fuel is the only one of the four items which has shown a decrease, the cost of food and labor still being abnormally high—a fact which emphasizes very strikingly the advantages of electric cooking.

Completely Wired Homes

WITH the campaign to "Own Your Home", which is beginning to bear fruit, the public, now in a home-building mood, will be susceptible to the slogan "Electrify Your Home" and the suggestion to have ample outlets conveniently located. Electrical men must drive these facts home by publicity and by educational means with the prospective home owner, the architect and the contractor. A home not wired is not modern. A home not completely wired and with all outlets in use is a home that fails to pass the test of present-day standards.

The Victory Liberty Loan

VIGOROUS action should be taken by every patriotic citizen within the next three weeks in subscribing to the Victory Liberty Loan and inducing friends, neighbors and associates to subscribe liberally and promptly. The war has been won, but we still have about 1,400,000 of our boys "over there." They must be brought home and the injured among them restored to health and useful life.

To do this will cost considerable money. Uncle Sam has already had to borrow large amounts since signing of the armistice to care for army and navy needs during gradual demobilization. He is asking for this last big loan from the public to meet these obligations. We are not asked to give, but merely to loan for a few years on the best security and most favorable terms probably ever offered by a government. We must not forget that we have won the war. Therefore, let's live up to the reputation of electrical men—be live wires—and let's finish the job now!

Opportunities for Flood Lighting

DURING the war the application of flood lighting as a protective measure made very rapid advances. Munition plants, railroad yards, docks, warehouses, etc., soon discovered that a high degree of safety was afforded at night by a well lighted exterior, with the result that thousands of installations were made.

In times of peace the opportunities for flood lighting are even greater than during war, especially for advertising and decorative purposes. The advantages already gained by flood lighting should not be lost—indeed, it will pay to devote more attention to this growing field.

Biggest Thing in Civic Life

UNDER the title "What Is It Chicago Most Needs?" J. E. Otis, vice-president of the Union Trust Co. of Illinois, said:

"The thing I would emphasize most forcibly is the importance of establishing, on a firm basis, an understanding between the public service corporations and the city. In order that public service corporations may keep pace with the demands of a city growing like Chicago, they must have the credit needed to finance themselves. They are absolutely dependent upon the sale of their securities for growth and extension. This credit can be assured only by a complete understanding between these public service corporations and the municipality, for the reason that sudden changes in these relations affect the securities and change their value. This spoils their marketableness."

Successful House-Wiring Method

EXCELLENT results obtained by the Commonwealth Edison Co., of Chicago, in securing old house-wiring business as described in this issue warrant the careful consideration of its methods by contractors and central stations wishing this work. This method consists, briefly, in formulating a schedule of outlet prices applicable to the various types of buildings, which permits the cost of wiring to be easily and quickly estimated. A proposal based upon this price, acceptable within 30 days, is sent in reply to every inquiry, whether the prospect appears "live" or not. In this way the prospect has a definite reminder of the wiring and its cost and when seized with the impulse can sign the contract before changing his mind. By means of a follow-up system the prospect is given an additional reminder from time to time. A similar system might be adopted in smaller towns and easily extended to include all unwired homes.

Turbogenerator Fires and Fighting Them

TURBOGENERATORS have caught fire and damaged themselves severely and in some instances irreparably. Expressed as a percentage of the total number of turbogenerators in service, the number that have caught fire is very small probably. But those that have, have caused a loss to those concerned so that hereafter the question of preventing fires and alleviating their effects is an important matter with them.

A turbogenerator is not an inflammable piece of apparatus, but it contains a certain amount of material that is combustible. A short circuit or some other form of heat or flame occurs. This is fanned into flame to form an intense heat locally by the high air velocity of the generator cooling air, which also carries the flame around the machine, making the damage the more extensive. Under the influence of intense local heat, of a blow-torch effect because of the high air draft, laminations are burnt away, copper is burnt and seared, and the machine may be rendered useless without complete re-winding of turns and stacking of new laminations.

The use of mica-insulated coils instead of cambric insulation, the adoption of metallic wedges and spacers in place of wood and fiber, tend to reduce the combustible content of a turbogenerator, hence the extent of the damage done in the presence of short-circuits, sustained arcs and high air velocities such as sometimes do occur will be more restricted. However, with fires as a possibility to be recokned with, it would seem that other steps than depending upon the manufacturer to prevent havoc being wrought by restricting the area affected when a fire does occur devolves upon the operating company.

When a turbogenerator catches fire it would seem that the first three things to be done are to prevent the flow of current from the system into the generator and by the generator into itself by immediately killing the excitation, and to stop the influx of air with its oxygen content upon which combustion depends. With these things accomplished, it then remains to put out the fire. With the air inlet to the generator closed, also the outlet, the gases of combustion circulating around the generator and external air excluded, the tendency would be to quench the fire. More heroic measures are required, however, but what measures should be is as yet a mooted question.

Water is available, is satisfactory, but causes insulation troubles that might, in small fires, prove more costly than the loss by fire. Steam has been advocated as not offering the disadvantages that does water so far as concerns dielectric difficulties. On the other hand, it possesses drawbacks in that the cooling effect of water is not available since the steam contains latent heat; and we do not know to what extent considerations involving superheating enter at the higher temperatures. Another liquid that suggests itself is carbon tetrachloride. The fire-extinguishing characteristics of carbon tetrachloride are well known. It does not attack insulation, although it is used commercially as a solvent for rubber. It possesses high dielectric properties. In using it, it should be borne in mind that when admixed with air it becomes quite a powerful anaesthetic, hence should be used where there are ample facilities for ventilation or for escape for the fire fighters. Carbon dioxide, a gas, also suggests itself for quenching fires in such inaccessible places as inside turbogenerators and large oil-filled transformers.

Turbogenerator windings are inaccessible at best. It has been found impossible to reach them when an internal fire is raging, because the exterior becomes hot, so intensely hot that discoloration takes place and the casing plates cannot be removed. It would appear, therefore, that means should be furnished by which water or steam, carbon tetrachloride or carbon dioxide or whatever fire-fighting medium is employed can be applied to the fire quickly and easily, which means without having to unbolt cover plates that are too hot to touch, etc.

Although comparatively few large turbogenerators have caught fire, those that have have demonstrated that internal fires cause extensive damage and may entirely wreck the machine. Although fires have been few and far between, the results have been such that precautions appear to be justified, the more so since their cost is negligible in comparison to the expense of a fire. The precautions against fire that suggest themselves are, firstly, to eliminate combustible material wherever feasible in generator design; secondly, have facilities for shutting off the air supply rapidly; thirdly, equip generator casings with valves or openings by which some fire-quenching medium can smother the fire. The expense of these fire-fighting precautions is relatively negligible.

Need for Industrial Lighting Codes

IT IS a common saying that we have too many laws. Of the great plethora of statutes there is a high percentage that never should have been enacted, because they are inadvisable, impracticable or non-enforcible. Most of the laws in this group were hastily or improperly considered. One should always proceed cautiously, therefore, in advocating additional legislation. And yet wholesome laws are needed both to promote the general public welfare, where this can be done in a clearly constructive manner, and also to check those who maliciously ignore the rights of their neighbors.

Legislation affecting lighting falls in a class that requires particular consideration because few of the average law-makers know more about the principles of illumination than does the general public. It is on this account that we find some very vague or even absurd state laws and city ordinances regarding automobile and locomotive headlights, these frequently specify-

ing regulations that can never be enforced properly

Consequently, illuminating engineers properly have hesitated before advocating enactment of laws specifying lighting requirements. The only reason that prompts them to recommend such legislation is the conviction that much positive danger results from improper or inadequate lighting. Such poor lighting is due in almost all cases to ignorance of true lighting principles. If this could be removed by universal education on illumination the need for legislation would disappear. Education of the general public is a very slow process, however, during the carrying out of which incalculable harm may be produced by insufficient use of light or misuse of light, harm that may be almost entirely obviated by well considered and enforcible legal regulations.

The very rapid development of our industries has been accompanied by several evils, of which one of the worst has been the appalling number of fatal and serious industrial accidents, averaging some half million every year in spite of the persistent "Safety First" movement conducted during the last ten or so years. The prevalence of these accidents was one of the causes that led to the establishment in practically all our states of factory-inspection departments charged with periodic examination of every workshop or plant to see that glaring causes for possible accident, fire or other calamity be removed before the misfortune occurs.

In the last ten years the opinion has been forced on safety experts by convincing evidence that a large percentage of industrial accidents, variously estimated as from 18 to 25%, is due to inadequate or improper lighting and could be almost entirely eliminated by proper attention to this matter. It has also been shown that gradual deterioration of eyesight of workers results from long continued labor under poor lighting conditions. Here we have two definite and serious results from bad lighting that it would be highly inadvisable to neglect when this can be remedied so easily after being officially called to the attention of the plant owner or other responsible person at the same time that other manifest causes for dangerous conditions are pointed out by the factory inspector.

To give the later proper authority and guidance as to lighting it has been found necessary to draft factory lighting codes. Four states have already adopted such codes and several others have the matter pending. The subject is a very lively one because of the growing interest in better factory lighting. It is very fitting, therefore, that the status of these codes should be reviewed at this time by illuminating and electrical engineers, as has been done in joint meetings held in New York and Chicago, based on a clear resumé of the subject by Mr. George H. Stickney, as reported in this issue. It is to be hoped that Mr. Stickney's paper and the discussion of it will lead to development of similar codes in all the industrial states so that the accidents needlessly due to lighting may be minimized and the vision of workers conserved.

Progressive Factory-Lighting Campaign

OHIO has among its many distinctions the possession of one of the most progressive state central-station association. Of the numerous distinctive features of the Ohio Electric Light Association is its group of active committees dealing with meters, illumination, new-business co-operations, station operating, transmission and distribution, and standardization of voltages. Each of these six committees has accomplished much good in the last few years not only in the ordinary way, but by a unique method of conducting the meetings.

A splendid example of this was shown last week in the group of three meetings held by the association's Illumination Committee in three Ohio cities, as reported on other pages of this issue. These meetings were some of the initial efforts in a general campaign for improvement in factory lighting. It has been felt that two things were necessary to stimulate this campaign, first, to interest the central stations, contractors and others who would be concerned as to the benefits to be derived by all parties from active promotion of better industrial lighting, and, second, to educate these parties on the principles of illumination so that a satisfactory lighting system could be designed.

Good speakers were secured to point out the opportunities in factory lighting betterment for central stations, contractors, producers of lighting equipment, the owners and employes of the factories themselves, and the general public. The arguments most effective in securing the interest of plant owners and superintendents were also set forth and how co-operative effort by the various electrical interests brings best results.

Another very effective educational means has been developed by the committee in question. In co-operation with the Electrical Engineering Department of Ohio State University it has brought out a special correspondence course on industrial illumination that is available not only to members of the O. E. L. A. but to anyone interested in the subject. This course is offered at a nominal fee and gives the latest authoritative information on this matter, both in the form of technical leaflets and policy leaflets. In further co-operation with the leading manufacturers of lighting equipment, the committee has made it possible for all who take this course to secure the most recent and valuable trade publications dealing with industrial lighting.

At the numerous hearings held in recent months on the proposed Factory Lighting Code of Ohio, the movement for improvement of industrial lighting was also given impetus. Through all these widespread yet well co-ordinated and co-operative efforts the committee has undertaken its campaign in a most effective manner and it is to be expected that it will bear excellent fruit. In fact, it is not unlikely that it will stimulate similar campaigns in other industrial states and thereby help to bring up a nation-wide acceleration of factory lighting betterment.

Week's Events

Lighting Codes Considered at New York and Chicago— Ohio Factory Lighting Campaign — Business Conditions

PRESENT STATUS OF INDUSTRIAL LIGHTING CODES DISCUSSED.

Joint Meeting Hears George H. Stickney's Paper—Discussion by Engineers and State Officials.

An excellent review of the industrial lighting codes that have been adopted in four states and in many Federal Government establishments and which are pending in several other states was presented in a paper on the "Present Status of Industrial Lighting Codes" by George H. Stickney, before a joint meeting of the American Institute of Electrical Engineers and the Illuminating Engineering Society held in New York City on April 11. A particularly interesting discussion followed in which there participated men who had helped draft the codes, plant managers who were governed by them, representatives of governmental bodies that are administering the rules, and engineers interested in the entire subject.

Mr. Stickney's paper is a comprehensive resume of the code situation as to history, requirements and enforcement. The prime function of these codes is to safeguard life, limb and vision of industrial workers; incidentally, they teach practice that enhances the earning power not only of the workers but also of the industrial plants. Inadequate lighting being a prolific cause of industrial accidents and of gradual impairment of lost visual power, there exists a definite need for regulations calling for at least a minimum standard of illumination. Practically all the factory lighting codes now in force or being prepared are based on the "Code of Lighting Factories, Mills and Other Work Places" drafted by the Illuminating Engineering Society in 1915. Pennsylvania and New Jersey adopted the I. E. S. code with certain minor modifications. Wisconsin last year revised its code to conform in many respects with the revised I. E. S. code, and New York adopted the code with other modifications. Among the states where codes are pending are Ohio, California and Oregon. The Federal Government also has codes governing lighting in certain of its establishments. The state codes are backed by the state police power.

The principal specifications in the codes relate to intensity, glare limits, and distribution. In some of the codes emergency lighting and switching arrangements are called for. Adequate daylight is usually required and, if specified, is to be twice the intensity of artificial illumination. The specification of the latter constitutes the principal item and in all codes is now specified in foot-candles for different grades of work; only the minimum values are made mandatory, but higher values are recommended as much more desirable. The New York code and the proposed Ohio code contain in the supplement detailed lists of standardized processes and their intensity requirements. Glare-limit specifications, while much more difficult to define, are extremely important; the New York and Wisconsin codes, especially the latter, take up this matter in more detail. Distribution of light is usually to be such as to avoid objectionable shadows and sharp contrasts. In some of the codes emergency lighting is called for to prevent panics in crowded rooms when the regular lighting has failed during an emergency. To promote safety for watchmen and avoidance of carrying lanterns, some codes require convenience in switching.

On behalf of the inspectors, electricians and others who must see to carrying out the provisions of the lighting codes, these have been made as simple as possible and readily understandable. There is need for much educational work among these men, however, to explain to them the principles of modern lighting practice. In conclusion, Mr. Stickney feels that the development of these codes has been very wholesome and effective, in contrast with numerous examples of vague and non-enforcible legislation regarding headlights, for instance. Illuminating engineers are agreed that industrial lighting codes should be adopted in each of the states. Differences in details will gradually disappear after experience in application has been sufficiently extensive.

In the discussion of the paper it was pointed out by several speakers that technically educated engineers prepare lighting codes, but untrained inspectors are called on to interpret and enforce them. Prof. C. E. Clewell suggested three expedients for obtaining satisfactory interpretation. They are (1) the education of inspectors, (2) improved and simple measuring devices to check the inspector's judgment, and (3) the elimination of questions depending on judgment.

Dr. E. B. Rosa, of the United States Bureau of Standards, emphasized the element of education. He classified those to be educated into (1) those who prepare the codes, (2) engineers and designers of lighting systems, (3) employers and managers, and (4) employes.

W. P. Hurley also emphasized the educational element by saying that the present codes are more nearly perfect than is the general understanding of the subject of industrial lighting.

The work which the Bureau of Standards has done in arranging for lighting in arsenals and navy yards during the war was described by Dr. M. G. Lloyd. He mentioned the fact that the Bureau has prepared and is publishing four Federal lighting codes which follow the I. E. S. code, but which are much more comprehensive than that code. The Federal codes will include recommendations for their application on a much larger scale than any codes yet written.

Ward Harrison, of the Engineering Department, National Lamp Works, reminded the meeting that the matter of illumination of industrial establishments is yet in its development state. To have slightly different codes in the various states is more desirable at first than to have a universal code. The most satisfactory items from the several codes can be collected into a single code later on.

John Vogt, of the New York State Labor Depart-

ment, reviewed the work of that department in improving lighting conditions. He also emphasized the importance of education on this subject. New York inspectors attend a department school one day every two weeks. The results from 15,000 tests of lighting plants which the department has made are digested for the benefit of the inspectors. Moreover, the inspectors are instructed in the principles of sanitation, lighting, and safety, and in code requirements and interpretations. The accomplishments of the department in obtaining compliance with the requirements of the code are indicated in the following table. The lag of compliances is a natural condition since a certain amount of time for compliance is allowed. The lag does not represent any objection by employers to compliance with the orders of the department.

Month	Year	Orders Issued	Compliances
Aug	1918	35	67
Sept.	1918	174	27
Oct.	1918	611	88
Nov.	1918	546	156
Dec.	1918	446	205
Jan.	1919	608	517
Feb.	1919	765	506
Total		3,185	1,566
Regular inspections made			56,236
Special inspections made			4,791

That the existence of different codes in different states does some injustice to the manufacturer of lighting equipment and to manufacturers operating plants in different states was alluded to by C. B. Auel. The existence of 48 different codes is undesirable—is, in fact, detrimental to some employers willing to comply with codes. The boiler code is an example of a single code for all the states. Compliance with it is simple, because it is universal. The requirement in some of the present codes for emergency lighting systems necessitates the installation of a dual system in some instances. Such an installation is unfair to the owner of the plant. The codes should make provision for such exceptional occurrences.

Mr. Stickney also presented this paper at a joint meeting of the Chicago sections of the two societies on April 17. A report of the Chicago meeting will be given in our next issue.

OHIO LIGHTING MEN CONDUCT FACTORY ILLUMINATION CAMPAIGN.

Illumination Committee of Ohio Electric Light Association Holds Meetings in Three Cities to Instruct Central-Station Men and Contractors.

An important movement to stimulate general interest in and give instruction on modern factory illumination has been inaugurated by the Illumination Committee of the Ohio Electric Light Association. It was given decided impetus by holding three one-day meetings on April 9, 10 and 11 in Columbus, Toledo and Akron, respectively, in each of which two sessions were held under the chairmanship of F. C. Caldwell, professor of electrical engineering, Ohio State University, Columbus.

The morning session in each of the three cities was a closed meeting for O. E. L. A. members and their lighting salesmen and engineers. Talks were given by G. S. Merrill, of the Engineering Department, National Lamp Works, and by George W. Hill, of the Society for Electrical Development. The opportunities for central-station men to take up active promotion of improved factory lighting, the arguments to be used most effectively, and what has been accomplished in this line by the most progressive central stations were pointed out. General discussion followed in which local central-station men participated freely and drew out further information.

Each of the afternoon sessions was an open meeting to which not only members' representatives, but also contractor-dealers and all others interested in lighting development were invited. Four addresses were made at each of these open sessions, two dealing with the opportunities in this field and the value of co-operation in developing it, and the other two being more of technical character. George W. Hill, of the Society of Electrical Development, made one of the addresses on co-operation; the other was delivered by a local central-station engineer. At Columbus it was W. A. Wolls, of the Columbus Railway, Power & Light Co.; at Toledo, W. E. Richards, Toledo Railways & Light Co.; at Akron, D. MacNaughton, Northern Ohio Traction & Light Co. The technical addresses were made by H. H. Magdsick, of the Engineering Department, National Lamp Works, Nela Park, on "Illumination Design"; and by Prof. F. C. Caldwell on "Illumination Measurements."

The Akron meeting was typical of the series and will be briefly reviewed. In opening the meeting, Professor Caldwell spoke of the objects of the Illumination Committee's campaign, which aims to interest everyone concerned with factory lighting, to show how all can profit from its development, to furnish instruction on the technical features involved, and to explain the proposed Code of Industrial Lighting of Ohio. The committee has co-operated with Ohio State University in preparing a special correspondence course on factory lighting which is available to anyone interested for the nominal fee of $2. This course is issued by the University and details concerning it can be obtained by addressing Professor Caldwell at Columbus, Ohio.

George W. Hill spoke on "Co-operation in Improving Industrial Lighting." During the war the value of better factory lighting was demonstrated as a means of accelerating and improving production in the important war industries. The likelihood of keen competition emphasizes its value for the near future. In Ohio the movement has been taken up very progressively, but to achieve the best results it is necessary to have all interests combine in a co-operative and coordinated campaign. The Society for Electrical Development, which has conducted several national co-operative electrical campaigns successfully, is ready to lend its aid for furthering the movement in every possible way. Mr. Hill asked that the society be called on, as it has much printed matter available for distribution.

D. MacNaughton spoke of industrial lighting from the central-station standpoint. Drawing on his own experiences since 1913, many plants were mentioned whose obsolete lighting was modernized. Arc lamps and carbon incandescents were replaced by Mazda lamps with suitable reflectors. In a survey undertaken in Michigan in 1915 it was found that only a small percentage of factories were using modern efficient lamps. Mr. MacNaughton early became a convert to general illumination of factories and felt that state regulation of the matter would become necessary. He spoke of the opportunities of central stations to set a good example by improving their power-house lighting. The central-station illuminating engineer should also be trained as a power engineer because the lighting and power loads should be considered as a coordinated problem.

H. H. Magdsick said that factory lighting was a good field to begin lighting betterment because its requirements are relatively simple as compared to residence lighting, for instance, where consideration must be given to the esthetic. Its design can also be reduced to rules involving chiefly arithmetic only. The first thing necessary is to decide on the illumination intensity needed on the work and in the intermediate spaces. Safety and conservation of vision require at least a minimum intensity, but this must be greatly exceeded in order to obtain economical production. The older industries have inherited low lighting intensities, whereas many of the newer ones, such as automobile and tire manufacture, appreciate the productive value of higher intensities. These higher values keep the men more alert and active, avoiding accidents, paying keener attention to the work so there is less spoilage and more work turned out. Bright, cheerful rooms make the workers more contented also. The cost of lighting is low compared with the rental of the premises, consequently it often pays to run two shifts instead of add more space. Mr. Magdsick discussed glare and its elimination, also the need for having directed light to detect form and contour. Absolute uniformity of illumination is not desirable; shadows are needed, but they must not be very dense as a rule. Selection of reflectors must be done to secure efficiency, accuracy of distribution desired and durability. Examples of modern units were shown.

Professor Caldwell reviewed the history of the proposed Ohio Code, on which a few more hearings will be held before it is made mandatory. Its rules are very simple. They are supplemented by a long list of intensities recommended for different industries and operations. He then described the methods of measuring illumination intensity and showed how it is effected in the Sharp-Millar, Weber and Macbeth instruments and the foot-candle meter and lumen meter.

MANUFACTURERS' REPORT SHOWS BUSINESS IN POOR CONDITION.

Interesting Facts Brought Out by Survey Recently Completed by National Association of Manufacturers.

The post-armistice trade conditions survey just completed among the 4400 establishments comprising the membership of the National Association of Manufacturers shows with the exception of 5 out of 22 principal groups of industries throughout the United States, business activity is approximately between 25 and 50% normal. The five divisions reporting a predominating condition of present business prosperity are the jewelry and silverware, musical instruments, vehicles, including automobiles, rubber and tobacco. Of the remaining 17 groups, all except the leather and manufactures report business below 50% normal.

In the general order of importance the following factors are stated to be the chief obstacles now prevailing to prevent general business activity:

1. Delay in signing the treaty of peace.
2. General high costs of labor and materials.
3. Sudden cessation of war buying operations by the United States and foreign governments.
4. Hand-to-mouth buying by jobbers, retailers and consumers awaiting expected price reductions.
5. Continued government control, management and operation of railroads, etc.
6. Sudden imposition of heavy war revenue tax burdens on industry.
7. Labor unrest, agitation and industrial strife.
8. High prices of wheat due to government guarantee.
9. Unemployment and poor distribution of labor forces released from military or naval service.
10. Delay in settlement by Federal Government of claims for payment under informal war contracts.
11. Partial shutting off of important European markets due to import trade embargoes by Great Britain, France and Italy.

The production of iron and steel is universally regarded in business circles as the most reliable barometer of trade conditions. With respect to present business in this industry, the replies indicate that these important trade factors are in a comparative state of lethargy, due mainly to market and price conditions, as well as a general lack of buying on the part of the railroads. Similarly, it is found that 67% of the iron and steel manufacturing plants do not regard the trade prospects for 1919 as very bright. Machinery manufacturers, bearing a direct relation to the iron and steel trades, also report a high percentage of comparatively unsatisfactory present business conditions, and opinion regarding future prospects about evenly divided between fair and good.

Together with the request for a report on present business conditions and future trade prospects, the members of the National Association of Manufacturers were requested to report or register their opinion on the following topics:

Conditions of stock on hand as compared with normal pre-war supply.

The scale at which buying stands.

The relative importance of foreign and domestic markets for the immediate future.

Government ownership of public utilities.

Private ownership of public utilities under government regulation.

The repeal of the La Follette Seamen's Law.

Legalized fixed resale prices on trade-marked articles.

A legally vested national labor board to adjudicate disputes.

Imposing of statutory (legal) responsibility on trade unions.

Practically every industry in the 22 groups reporting on the conditions of manufacturing stocks in the hands of retailers or jobbers, compared with the normal pre-war supply, showed that stocks in such hands at the present time are far below normal, due, first, to war time curtailment of production in many lines; second, to a general stagnation of buying and market demands. The only notable exception to this statement is that shown in the reports received from food products manufacturers, indicating a predominating state of normal or over-stocks in those important trades. This is partially accounted for by the fact that the people generally have been cautious in their purchase of many food commodities in the hope (which has been realized to some extent) that prices would decline.

Briefly stated, the reports received from the manufacturers concerning the scale at which buying stands, shows that with the few exceptions of some necessary drugs, jewelry and silverware, musical instruments, vehicles, and certain branches of the rubber industries, purchasing activities by consumers, retailers or jobbers generally have been strictly limited and more or less on the hand-to-mouth basis, since the signing of the armistice.

Iron and steel manufacturers lead in the percentage

of those who replied in the negative to the inquiries concerning important buying activities. That the dearth of buying in these important trades was due mainly to price conditions has been commonly understood. It is the stated expectation of many of the manufacturers in these lines that improvement of buying will occur with the successful operation of the price arrangements which may yet be entered into by leading factors at the suggestion and with the support of the Industrial Board of the Department of Commerce.

Replies received to the question concerning the relative importance of foreign and domestic market demands clearly indicate that with the single exception of the brewing and distilling industries of America, whose future hopes of disposing of any available stocks of alcoholic beverages have now been practically diverted to foreign fields, the opinion overwhelmingly prevails that domestic market requirements are far more attractive for the immediate future than any which might arise from the reconstruction needs of the people of Europe.

In those industries reporting the greatest present condition of prosperity, namely, jewelry and silverware, musical instruments and vehicles, it is clearly demonstrated by the replies received that the hopes of these important trade factors are practically confined to domestic market demands.

An overwhelming percentage of the manufacturers replying to the question concerning their opinions on Government *vs.* private ownership of public utilities, record themselves as being in opposition to any form of Government ownership of railroads, or other public utilities, and strongly in favor, as an alternative, of returning the railroads to their private owners. Furthermore, there is noted a very strong demand in favor of private ownership of all public utilities under a more reasonable and limited form of governmental regulation than that which prevailed in the period prior to the taking over of the railroads by the Government for war purposes. Those few who favored government ownership while admitting it a failure thus far, desired to give it a further trial under normal conditions.

A careful analysis of the replies to the question concerning opinion on private ownership under government regulation, shows that this alternative meets with very slight opposition. Many of those declaring themselves against, base their opinion, to a great extent, on opposition to any form or aspect of government regulation of public utilities, even with private ownership in effect, on the ground that any form of interference with private management does not produce a favorable impression or result.

As a means of aiding the private development of an American merchant marine, the manufacturers recorded themselves as being heartily in favor of a proposal to repeal the La Follette Seamen's Law. In certain somewhat important industrial groups, some limited opposition to this proposal was found, but analysis of these replies clearly indicates that opposition is directed mainly at the idea of repealing and shows itself to be more in favor of modifying the law as against its repeal. In the main, however, an overwhelming majority register the feeling that the repeal of the La Follette Act is desired as one of the immediate and necessary steps toward the permanent solution of the merchant marine question.

The results of a canvass among the members of the National Association of Manufacturers on proposition to legalize fixed resale prices shows that in some of the industries where commodities are already being produced and distributed under registered trademarks, and where it might be expected that opinion would be predominating in favor, a rather surprising note of opposition is discovered. For example, in the food products industries two-thirds of the manufacturers express themselves as opposed; 61% of the manufacturers in the textile trades likewise declare themselves as opposed; and 63% of the machinery manufacturers similarly recorded themselves. In various industries where the issue of fixed resale prices has been prominent in recent years, and considerable thought given to the question, manufacturers are found to be largely in favor of the legalization suggested.

With some important qualifications and conditions, a good proportion of the members of the National Association of Manufacturers declare themselves as being in favor of the organization by law, of a national adjustment board, predicated upon voluntary agreement, for the settlement of labor disputes. It is evident from comments made by those who voted, that general dissatisfaction towards the present National War Labor Board exists in the minds of a large number of manufacturers. Notwithstanding these expressions of feeling, it was clearly indicated that a good majority of the employers are in favor of the principle of labor dispute adjudication through a properly constituted national board, legally created, and vested with adequate authority to enforce its rulings after the issues have been voluntarily submitted to it for decision.

Placing of statutory responsibility on trade unions for their contracts and for the acts of their agents as a means of eliminating or restraining many of the irresponsible elements among labor organizations is a proposition that American manufacturers heartily favor. Such a step, it is felt, would do much toward inspiring greater confidence than now prevails among employers in those who lead organized forces of workers, and in the good faith of labor organizations.

INTERESTING LIGHTING EXHIBIT PLANNED FOR VICTORY CONVENTION.

"New Spirit of Lighting" Special Feature at Forthcoming N. E. L. A. Convention.

An interesting feature is being planned for the coming convention of the National Electric Light Association at Atlantic City for the purpose of expressing to the industry what has been called "The New Spirit of Lighting." It is the new attitude towards the subject of lighting which has been bred by the war and post-war conditions that has for its objective the economic adaptation and application of lighting in its many fields of usefulness. Through the Lamp Committee, co-operating with the Lighting Sales Bureau of the Commercial Section and the lamp manufacturers, these more interesting aspects of modern lighting are to be presented in the form of a special exhibit to occupy a conspicuous position in the exhibition hall at the convention.

This special lighting exhibit will be composed of ten separate booths or sections, the outstanding features of which will be very elaborate presentations of industrial, store, window and home lighting. The industrial lighting exhibit, for instance, will be a typical modern machine shop with machinery representing several classes of industry installed and running. Illumination will be provided by three systems of lighting. One will show the too prevalent scale of poor lighting; another, a good standard of illumination, and a third will present what is considered the best productive

intensity. These several systems of illumination will be operated from a control pedestal and will be demonstrated by the man in charge to all interested visitors. At other times this control pedestal will be automatically operated by a flasher as a constant demonstration of the effectiveness and efficiency of good lighting in a factory.

For the purpose of demonstrating the best modern standards of show-window illumination, a life-size show-window will be installed in which there will be a practical display of merchandise. It is expected that this display will be changed daily during the convention under the guidance of some prominent Atlantic City or Philadelphia department store. This show-window will be equipped with some 15 different systems of show-window lighting, demonstrating different intensities of illumination from different directions. These systems also are to be operated from a central control table and automatically demonstrated at such periods as they are not being specially displayed.

There will be another space devoted to home lighting which will comprise a number of typical rooms, characteristics of a modern moderate-priced dwelling such as represents in a large measure the home lighting problem of the day. These rooms will be illuminated by a very flexible system of lighting which will enable the operator to demonstrate the advantages of different types of fixtures and different ideas in the arrangement and location of lighting outlets. There will be a variety of portable lamps in use, not as an exhibition of the lamps themselves, but merely incidental to the illumination. This equipment will also be operated from a control pedestal.

Then there will be other sections given up to the display of indoor lighting equipment and outdoor lighting equipment. There will be a room devoted to the newer applications of lighting, such as the moving-picture field and the use of projector lighting. There will be a room given up to central-station lamp practice, illustrating the report of the lamp committee on the standardization of voltage, recent experience in the merchandising of lamps and other data showing what central stations are doing in the lighting field in different cities. In another section will be gathered together the educational literature available at present on lighting subjects. Here will be files giving a key to the different items of equipment featured in the different parts of the exhibition, standard and special equipment now in use in varying phases of lighting prospects and other general information.

The foyer of the lighting exhibit will be attractively furnished as a rest room and entirely illuminated by portable lamps. At the end of the foyer will be a moving-picture screen where a large number of exceedingly interesting films, both on lighting and other electrical subject, will be shown. The moving-picture machine will be located in the room given over to new lamp applications and will be operated in a fireproof glass booth.

Undoubtedly, this year will see great great acceleration in the popular interest in lighting subjects and in the general activity of the central-station industry in the development of this field. Much has been learned through the war period of the economic influence and value of specific types of lighting under definite conditions and the effort of the industry will be to apply this knowledge more broadly. It is this new spirit of lighting which this special lighting exhibit will define and present to the convention, and it is believed that it will have a very helpful and stimulative effect. For the benefit of the men who will be unable to attend this convention, this lighting exhibit will be very carefully photographed and a report will be published for general distribution which will carry the message as far as is possible on paper.

Partial List of Exhibitors at N. E. L. A. Convention

Present List of Exhibitors Takes up Entire Original Allotment of Exhibition Space at Atlantic City Convention, May 19-23—Exhibition Committee Arranging for About 3500 Sq. Ft. Additional Space, Which May Be Insufficient for Large Number of New Exhibitors Making Applications.

Sangamo Electric Co., Springfield, Ill.
Wagner Electric Manufacturing Co., St. Louis, Mo.
Electrical Review, Chicago, Ill.
Hoover Suction Sweeper Co., New Berlin, Ohio.
Rathbone Sard Electric Co., Albany, N. Y.
General Electric Co., Schenectady, N. Y.
Western Electric Co., New York City.
Packard Electric Co., Warren, Ohio.
Albert & J. M. Anderson Manufacturing Co., New York City.
Independent Lamp & Wire Co., New York City.
Naugle Pole & Tie Co., Chicago, Ill.
Delta-Star Electric Co., Chicago, Ill.
Federal Sign System (Electric), Chicago, Ill.
C. H. Wheeler & Co., Philadelphia, Pa.
Edison Storage Battery Co., Orange, N. J.
Hurley Machine Co., Chicago, Ill.
Pittsburgh Transformer Co., Pittsburgh, Pa.
H. W. Johns-Manville Co., New York City.
Borne Scrymser Co., New York City.
Palmer Electric & Manufacturing Co., Boston, Mass.
Leeds & Northrup, Philadelphia, Pa.
Rumsey Electric Co., Philadelphia, Pa.
Eureka Vacuum Cleaner Co., Detroit, Mich.
Jeffery-Dewitt Insulator Co., Huntington, W. Va.
Philadelphia Electric Co., Philadelphia, Pa.
Allis-Chalmers Manufacturing Co., Milwaukee, Wis.
Elliott-Fisher Co., Harrisburg, Pa.
Electrical World, New York City.
Hubbard & Co., Pittsburgh, Pa.
Moloney Electric Co., St. Louis, Mo.
Landers, Frary & Clark, New Britain, Conn.
Edison Electric Appliance Co., Chicago, Ill.
Electric Service Supplies Co., Philadelphia, Pa.
Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.
Electric Storage Battery Co., Philadelphia, Pa.
Baker R. & L. Co., Cleveland, Ohio.
Commercial Truck Co. of America, Philadelphia, Pa.
Ward Vehicle Co., Mount Vernon, N. Y.
Walker Vehicle Co., Chicago, Ill.
American Electrical Heater Co., Detroit, Mich.
Electric Vacuum Cleaner Co., Cleveland, Ohio.
Norris Iron Works, Long Island City, N. Y.
Simplex Electric Heating Co., Cambridge, Mass.
Square D. Co., Detroit, Mich.
George Cutter Co., South Bend, Ind.
G. & W. Electric Specialty Co., Chicago, Ill.
Philadelphia Electrical & Manufacturing Co., Philadelphia, Pa.
Tabulating Machine Co., New York City.
International Time Recording Co., New York City.
Electrical Record, New York City.
Railway & Industrial Engineering Co., Pittsburgh, Pa.
Detroit Stove Works, Detroit, Mich.
Remmert Manufacturing Co., Belleville, Ill.
Metropolitan Engineering Co., Brooklyn, N. Y.
American Ironing Machine Co., New York City.
Central Electric Co., Chicago, Ill.
Electrical Testing Laboratories, New York City.
American Conduit Manufacturing Co., Pittsburgh, Pa.
Ohio Brass Co., Mansfield, Ohio.

Commercial Practice

Appliance and House-Wiring Campaigns—Railroad Track Heaters—Employes Building Fund—British Merchandising

BROOKLYN CENTRAL STATION HOLDS APPLIANCE SALES.

Vacuum Cleaner Campaign Being Carried on This Month —Electric Irons Special March Offering.

During the month of April the Brooklyn Edison Co. of Brooklyn, N. Y., is conducting a seasonable sale of electric vacuum cleaners. The special offering during this sale is a high grade machine which has been specially priced for the occasion. As an additional inducement to the company's customers a partial payment plan has been introduced which the purchaser is allowed five months in which to complete the payment. However a 2% discount is allowed for cash. The sale price includes in addition to the machine itself, a set of five attachments for cleaning stair carpets, upholstered furniture, draperies, shelves, mattresses, etc.

In connection with this sale the company is sending out to its customers an attractive folder describing the cleaner. Attached to this folder is a return postal on which the prospective customer writes his name and address and indicates the plan under which he intends to make the payments.

During the month of March a very successful electric iron sale was carried on along the same lines. Large purchases at former prices afforded the company the opportunity of offering the irons on this occasion at a special bargain price which was taken advantage of by a large number of its customers.

ILLINOIS CENTRAL STATION PROMOTES HOUSE-WIRING CAMPAIGN.

Public Service Co. of Northern Illinois Also Urges Installation of Additional Outlets and Conveniences.

The Public Service Co. of Northern Illinois is exerting every effort to stimulate activity in the wiring of houses located in its territory. This company serves a rather prosperous district in northern Illinois including the suburbs of Chicago and, although the percentage of houses wired in this district is much higher than the average, it is expected that through the efforts of the company and the co-operation of the local contractors the number will be materially increased.

The company for some time has had a two-year time payment plan for wiring in effect and has been co-operating with the contractors by allowing them to take contracts on this basis and purchasing such contracts from them. During the campaign this plan will be given wide publicity. In addition, in those parts of its territory where the company does not maintain a construction department, solicitors will be engaged to canvass the locality for the local contractors.

In the April *Sales Bulletin* of the company the importance of providing adequate electrical installations is strongly urged. Comparing the modern house-wiring installations with the automobile refinement, it states: "If the public knew no more about automobile refinements than it does about electrical conveniences, automobiles would be sold minus lamps, starters, tops, windshields and tools, and would be equipped with undersized tires and one-cylinder engines. They would run, but that's all. Most house-wiring jobs give light but that's all."

This lack of realization of electrical refinements is laid to the fact that the customer is usually buying electrical work on a price basis only and no attempt is made to point out to him the great advantages of oversized wiring, especially feeders, plenty of flush receptacles, switches, additional and emergency lighting outlets and other electrical conveniences and seldom is informed of the advantages of the many electrical appliances. It is pointed out that electric service today means more than the lighting of the home and the company's salesmen are strongly urged to advocate the installation of these electrical convenience features and the use of electrical household appliances as much as possible.

ELECTRIC HOUSEHOLD APPLIANCE CAMPAIGN IN NORTHWESTERN OHIO.

The Northwestern Ohio Railway & Power Co. is making arrangements to conduct an electric household appliance campaign in its territory for the sale of washing machines, vacuum cleaners, sewing machines, ranges, etc. These appliances will be sold either on ten monthly payments or for cash.

Arrangements have been completed by the Port Clinton Electric Light & Power Co. with the W. G. Nagel Electric Co., Toledo, Ohio, whereby the Nagel company will consign to the light company electric appliances, such as electric irons, toasters, sewing machines, electric power washers, electric ranges and vacuum cleaners for a campaign in the company's territory. Solicitors are to be furnished by the Nagel company to call on the lighting customers for the purpose of selling the appliances mentioned. The customers can either buy these appliances outright or on an easy-installment basis.

ELECTRIC HEATERS FOR RAILROAD TRACKS.

Simple Units Overcome Snow and Ice Troubles.

During the heavy snowfall last winter a somewhat novel form of electric heater was devised for use on certain British railways for keeping the points and switches free from frozen snow and ice. The heaters consisted of a length of resistance wire wound on a porcelain tube. This latter was centered between insulating disks and placed in lengths of 2½-in. gas. These tubes were about 1½ ft. in length, and these somewhat rough and ready heaters were coupled up

to lengths of ordinary rubber-covered wire and laid under the points to be protected. As soon as the current was switched on the snow naturally began to thaw and very satisfactory results were obtained.

Similar heaters have been in use on railroads in this country for some years, being brought out for service when snow begins to fall. The heaters take 11 amperes at about 36 volts, and for ordinary work they are used three in series across a 110-volt circuit. It has been found necessary to use 18 heaters for the turn-outs, and these simple but efficient appliances have been employed in large numbers under pipe runs, near signal mechanism and in the vicinity of the gearing for the turn-table pits.

CANADA CENTRAL STATION CREATES BUILDING FUND FOR EMPLOYES.

Fund Placed at Disposal of Employes' Association to Aid in Building Homes.

In order to assist its office employes to build or acquire homes during the present scarcity, George Kidd, general manager of the British Columbia Electric Railway Co., of Vancouver, B. C., has placed $50,000 at the disposal of the British Columbia Electric Office Employes' Association to be loaned at 6% over a term of 12 years. The scheme is believed to be one of the first of its kind to be launched in this province, if not in the whole of Canada, and it is already being gladly accepted by the company's employes.

"My reason for making the proposal," said Mr. Kidd recently, "was to relieve as far as possible our employes from the pressure of high rents, give them homes of their own and thereby induce thrift and interest in their community. Many of them have been inconvenienced, as are others, by having the homes they rent sold over their heads. Many others feel that paying out rent year after year without a permanent interest in their home is not desirable.

"Some of our employes already had lots but had not the wherewithal to build on them unless at high rates of interest, when the monthly charge for principal and interest would be much heavier than rent. It was these that we hoped to help, and in view of the need for more houses, we expect that it will induce some of our employes to build."

The disposal of the fund has been placed in the hands of a joint committee composed of representatives of the Office Employes' Association and the management of the company and the $50,000 has already been allotted by the committee. The employes have already, through the association executive, named their committee which will consist of A. E. Chamberlain, president of the association; J. Munro, vice-president; F. G. Graham and J. V. Armstrong, secretary and treasurer, respectively, and J. McNee, J. Freemont and H. G. Findlay.

BRITISH GOVERNMENT TO PROMOTE USE OF ELECTRIC APPLIANCES.

Minister of Food Asks Society for Electrical Development for Hints on Campaigns.

That England was preparing for active resumption of all forms of trade activities was apparent months ago when the Ministry of Reconstruction published a list of over 126 committees organized by the Government to meet reconstruction problems. Few Americans, however, have any idea of the degree and scope to which Great Britain is embarking on an energetic resumption of pre-war activities.

Among other industries to come under the attention of the Government for improvement and development is the electrical industry. In Great Britain the work of further popularizing electrical energy is to be done by the Government. And in considering the enlargement of the Government's activities, George W. Greenwood, British Minister of Food, has written to J. M. Wakeman, general manager of the Society for Electrical Development, commending the Society's campaigns for broader applications of electric service and requesting, for official purposes, copies of all material used.

Quoting from Mr. Greenwood's letter:

"In the reconstruction period following upon the war, the Ministery of Health and the Ministry of Reconstruction are both advocating a wide extension of the use of electricity in all forms of industry and also in the home for domestic purposes, such as cooking, heating and lighting.

"I understand that your Society has been established primarily with the object of popularizing the uses of electricity in the United States and that you have conducted some very efficient campaigns in this direction.

"Could you favor me with copies of your pamphlets, literature, newspaper articles, advertisements and any other material which is in your possession, such as photographs, etc., in order that I can submit them to the proper official quarter?"

CARROLLTON SHOWS UP AS REAL "ELECTRIC CITY."

Ninety-six per cent of all the houses in Carrollton, Ga., that are wired for electricity are using electric service. This is one of the facts revealed by the Georgia Railway & Power Co.'s sales department's recent survey in Carrollton. It is considered remarkably high. Six hundred and fifty houses are wired for service and only 24 are not using it. Very few homes are not wired.

The survey also showed that much more than 50% of the wired houses in Carrollton are using some form of electric heating device, flatirons predominating.

These two facts indicate better than a lot of argument could do it the progressiveness of that little city of 3300 population. It is one of the most thoroughly electric and up-to-date of all the communities that are on the Georgia Railway & Power system.

STORE WINDOW EXHIBITS.

The power of the window display to draw attention and hold it as compared with merely attracting the casual notice of the curious passer-by is the difference between clinching a sale and merely obtaining and then losing a "prospect." Window displays should be instructive, educational, and such that they appeal to those that the central station aims to reach.

Window exhibits can accomplish wonders in creating the market for washing machines, vacuum cleaners, electric ovens, etc., but the exhibit must be carried out upon sound principles if it is to be successful. Some of the leading appliance manufacturers are now sending men around the country to assist wide-awake utilities in making live, interesting exhibits of their products.

Operating Practice

Coal Storage—Converter Flash-Overs—Overhead Line Construction—Generator Fires—Good Boiler Room Practices

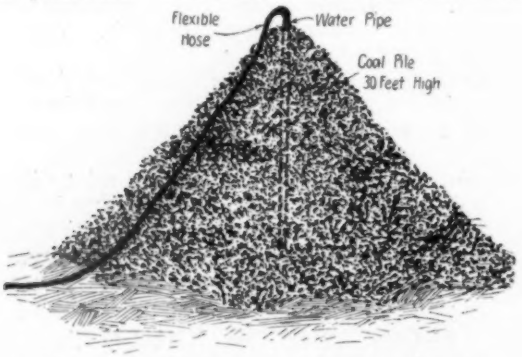
KEEPING THE COAL PILE COOL.

Practice of Middle West Company Saves 45,000-Ton Coal Pile.

All authorities on spontaneous combustion and the safe storing of coal strongly disfavor the use of water in fighting fires in coal piles. The reason is that in all except special uncommon instances the water has been unable to come into contact with the fire. The fire occurs in the pile; the water is fed only upon the outside of the pile, hence is unable to quench the burning coal.

One company in the Middle West had 45,000 tons of coal in storage. This company was forced to do two things that are thought to cause overheating of bituminous coal in storage. They were forced to mix the coals in storage, a proceeding thought to be a prolific source of coal pile fires. They also were forced to store their coal 30 ft. high and higher, whereas most authorities are strongly adverse to coal pile height above 18 to 25 ft. The coal pile represented a storage of 45,000 tons.

Heating of the coal pile occurred and in one section a fire actually started in the bottom center of the pile. The company then sunk several 2-in. iron pipes to the bottom of the pile, connecting their upper ends to a fire hose. City water was turned on and allowed to run for 48 hours. By that time the fire in the pile was quenched. The reason the water was effective



Sunken Pipe Supplies Water to Center of Coal Pile.

was, of course, because the water reached the burning coal in sufficient quantities to quench it; and at the same time cool off and thoroughly drench the surrounding coal. This same practice is commonly followed in the Navy, it is understood.

Since the above fire occurred this same company has adopted ventilation as a safeguard against heating and spontaneous combustion. The danger of ventilating a coal pile usually is that insufficient ventilation is attained and the air entering the coal pile only serves to hasten combustion instead of preventing it.

The manner in which ventilation was obtained in the present instance was by driving a 1½-in. iron rod down the full depth of the coal pile. The rod was then drawn out, leaving a clear hole the full depth of the pile, namely 30 ft. This proceeding was repeated at intervals of 3 ft., the holes being in a straight line. Similar holes were sunk 3 ft. to the side, so that the holes were staggered regularly throughout the pile. This method of ventilation has proved quite successful.

The objection advanced to this method might be that the holes bored would choke up. It was found, however, on digging out some of the coal for use, that the holes were clear cut and open, and remained open even when the coal was removed from one side of the hole. After a heavy snow fall it was found that the ventilating holes could all be located because the snow had sunk into them.

RELATION OF TROLLEY FEEDER TAPS TO MACHINE FLASH-OVERS.

Factors to Be Considered in Reducing Flash-Over of Railway Synchronous Converters.

Considerable damage can be done and service derangement is liable to occur by the flashing over of synchronous converters. Flash-overs are more prone to occur with converters supplying railway service than those machines supplying service to Edison systems, because of the higher voltage employed, namely, 600 volts as compared to 250 volts, and because of the greater and more sudden load variations that take place on trolley systems. In aiming to reduce converter flash-overs the subject of feeder taps has come to the fore, because it has been found that feeder taps are able to affect flash-overs very considerably.

The relation of direct-current trolley feeder taps to the source of power, or conversion, is of greater significance than is generaly recognized. However, after careful consideration, the benefits to be derived from placing these taps at reasonable distances from the apparatus are readily appreciated, as the reasons are both simple and logical.

It is common knowledge that a synchronous converter or direct-current generator will "buck" or flash-over if "dead short-circuited" across its positive and negative terminals. Now consider the positive feeders as a continuation of the positive terminal, and the negative return as a continuation of the negative terminal. It is evident that a short circuit near the substation on these feeders (or extended terminals) will cause the converters or generators to flash-over. Now follow the feeders (or extended terminals) a mile and short-circuit them. The chances are, unless the feeders are large, the machines will not flash-over.

There has been no change made in the converter, generator or switching devices in either of the above cases, but not withstanding this, the results have been inconsistent. The answer is simple. In the last case, there was no flash-over, the feeders (or extended terminals) having supplied enough reactance and resist-

ance to limit the current required by the short circuit to within the capacity of the machines.

No type of converting apparatus is free from flash-overs, providing the provocation is sufficiently great. There are, of course, other reasons for flash-overs besides "close in" taps, but at least 75% and perhaps 90% of the flashing nuisance is traceable to this cause. In consequence, producers of electrical railway power owe it to themselves, as well as to the manufacturers of their apparatus, to protect their machines in this simple inexpensive and fundamental way, in addition to the use of the protective features mentioned above.

No general or universal rule or formula has been advanced in fixing the tap distance from the machines. So many variables enter into the solution of the problem that it will prove quicker and more definite to solve each case by removing the "close in" taps until the resistance of the circuit becomes great enough to cushion and protect the machines. The principal variables which enter into the solution of tap distances are as follows:

(1) Capacity or Energy Behind the Rotary Converter.—It is obvious that for a given size of converter, the greater the capacity at the source of generation, the greater will be the damage resulting to the converter in case of trouble, and the nearer the converter and the alternating-current capacities agree, the less serious will be the damage resulting from trouble.

(2) Capacity of Converting Apparatus.—The larger the converting apparatus, the less sensitive it is to direct-current line troubles, since, for instance, feeder short-circuits are a smaller proportion of its capacity and therefore the machines are less subject to flash-overs from this cause, at least.

(3) Voltage of System.—The lower the voltage of a given system, the nearer the taps may be placed to the machines. In general, on a given system, tap distances for 1200-volt service should be at least twice those of 600-volt service.

(4) Size of Feeders.—The larger the feeders, the greater the tap distances should be from the machines.

(5) Disposition of Feeders.—When possible, the distribution of feeders should be such that each will carry a reasonable proportion of the station output—that is, where several feeders originate in one station, no excessive proportion of the station output should be handled over any single feeder. Any trouble on such a feeder reacts on the entire substation and is frequently responsible for flash-overs.

(6) Size of rails.—The heavier the rails, obviously, the greater should be the tap distances.

(7) Bonding.—Broken bonds and poor ground connections have been known to result in flash-overs. Such cases, however, are not frequent. Obviously, the bonding has a direct bearing on proper tap distances.

(8) Sizes of Cars.—It is evident that with a given substation unit, the heavier the car equipment and the larger the motor rating, the greater will be the "drag" on the substation equipment and the more destructive the effects in case of motor troubles. The rating of the car equipment has, therefore, a bearing on the proper tap distances, especially when the substation units are relatively small, as compared to the motor ratings.

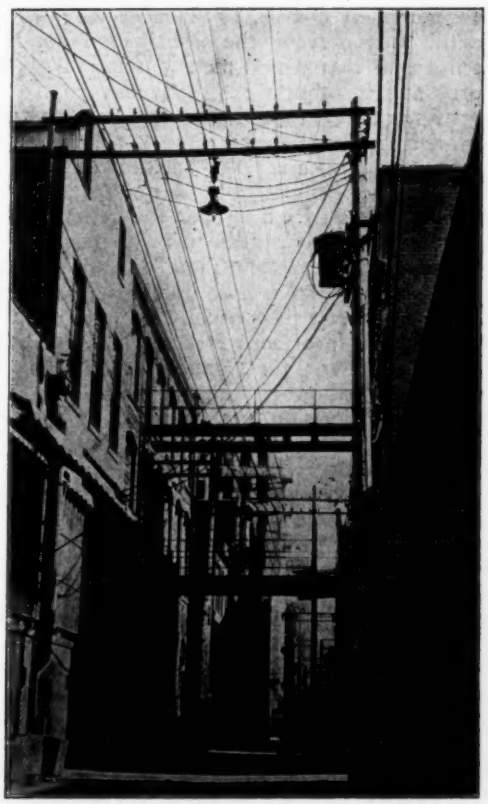
From the foregoing, it will be seen that a formula evolved to cover such a diversity of conditions would prove itself a problem and the results, until proven, could not be accepted as much more reliable than a guess. In general, experience has shown that on 600-volt systems, the first tap should not be nearer the machine than 2500 ft., and on 1200-volt systems, 5000 ft. Should flashing persist, these distances should be increased until the flashing stops. The line losses due to these tap distances are of little consequence when compared to the loss on account of flash-overs, including the time and expense involved in cleaning up the damaged apparatus. Furthermore, the car equipment is benefited by being worked at a more uniform voltage.

LINE CONSTRUCTION THAT ENDANGERS PEDESTRIANS AND FIRE DEPARTMENTS.

Form of Construction Where Disadvantages Outweigh Advantages.

The form of construction shown in the accompanying illustration possesses several merits so far as concerns the electrical and economic features of overhead line construction in localities where the overhead conductor loading is dense and yet not considered sufficiently dense to justify placing the overhead conductors underground.

The cradle construction shown, used considerably in certain sections of the West, enables a large number of wires to be carried through the same route



Form of Overhead Line Construction Criticised by Fire Underwriters.

without introducing difficulties due to clearances, excessive heights from ground, and dangers to linemen working upon the circuits. For a given weight of conductors carried, it is understood that the cradle construction is very economical. Moreover, trouble due to sleet, wind and snow is less likely to occur than when the conductor spacing is less liberal.

However, the form of construction shown has

met with very strong opposition from the fire departments of many cities. The wires being strung all across the alley increases the danger to firemen from shock and falling wires, such as so often occur in the neighborhood of a conflagration. The danger to pedestrians is also increased somewhat due to the conductors being spread fully across the alley instead of being concentrated within a comparatively narrow zone. In a recent issue of the National Board of Fire Underwriters' publication "Safeguarding America Against Fire" the form of overhead line construction shown was condemned as being unsafe, hence objectionable because of the hazards that may arise from its use.

PRACTICAL PRECAUTION FOR FIGHTING TURBOGENERATOR FIRES.

Commonwealth Edison Company Is Prepared for Emergency in Latest Large Turbogenerators.

Various methods of fighting the fires that sometimes do occur in turbogenerators are in vogue. The use of water and steam have found favor for putting out fires, while the use of carbon dioxide and carbon tetrachloride have been suggested. In all cases one of the first things to be done when a generator catches fire is, of course, to shut off the air intake, and in this way prevent the fire being fanned into an intense heat that would melt laminations, burn off end-turns and in other ways cause havoc.

In turning steam or water into a large turbogenerator, it has been found difficult to gain entrance to the generator once the fire has started. The heat produced has been found to be so great that it is very difficult and a belated job to open the generator casing through which water or steam may be played into the interior of the generator. Time is also required to obtain steam lines or fire hose unless they exist in the turbine room, which they usually do not.

After several disastrous fires in turbogenerators of 25,000 kw. and over, the Commonwealth Edison Co. has adopted a method of "preparedness" that is being employed until decision can be made as to whether water, steam or other medium is the more preferable for quenching a fire.

For two 25,000 and 30,000-kw. turbogenerators already installed the company has installed fire service connections in the generator casing, so arranged that water from the fire service system can be turned into the generator from the basement. For the latest turbogenerator of 35,000 kw. now being installed two fire hose connections are installed in the generator casing on the station floor. One of these connections is on each side and so arranged that water under pressure would play upon the end turns. A fire hose is laid beside the machine ready for emergency.

Placing hose connections in the generator casing permits service connections being made quickly—and speed counts, it prevents accidents occurring such as those due to turning on water under high pressure with a hose nozzle turned off, flooding of floors and adjacent apparatus, and thus tends to reduce the extent and seriousness of internal turbogenerator fires. Having a hose connection available, ready for connection with a water or steam line is preferable to having the water of steam line actually connected up, because of the possibility in the latter case of water leaks, or steam condensate entering the generator, or accidental opening of the valves.

MAKING DISCARDED CABLE SHEATHS USEFUL IN THE BOILER ROOM.

Minneapolis General Electric Company Uses Cable Sheaths for Boiler Tube-Hole Plates.

Another use for the lead sheaths of discarded underground cable has been found by the Minneapolis General Electric Co., Minnesota. This company delivers a quantity of discarded cable sheath to its Riverside Station. Here the lead sheath is cut up, melted down and poured into a mold for making gaskets for tube-hole plates of boilers. The mold or die used is very similar to that employed for making waffles. This die is bolted to a section of 6-in. steam pipe about 3 ft. in height at the base of which a flange acts as a firm foundation. The surplus lead and spillage that occurs when filling the mold falls through the steam pipe, where it can be readily reclaimed for use again.

The Minneapolis General Electric Co. claims the lead makes a very satisfactory gasket for the tube-hole plates of their boilers, and in making these gaskets the cost is negligible since they are made from lead having only junk value by labor employed around the plant. By following this practice, the company is no longer required to buy gaskets in the market.

CUTTING CLINKER WITH A WATER JET.

Water Jet Takes Place of Clinker Cutters and Power Dump.

In a large central station in the Middle West containing a number of underfeed stokers under 600 and 1320 hp. boilers a novel method of cutting the clinker that forms is employed. The coal used is Illinois coal, with high ash content, and clinkers considerably. The stokers are not equipped with either the power dump, clinker cutters or reciprocating grate.

As the green coal is pushed up through the incandescent fuel bed, coal already burnt is pushed along until it falls down the fuel bed toward the bridge wall. Much of the material, ash and clinker, falls through the space intervening between grate and bridge wall into the ash hopper. However, frequently the ash forms into large waves of clinker which fuse together. These large masses are too large to fall through the space between grate and bridge, but instead bridge across. It is to break up such large masses that the power dump, clinker grinder, etc., are used.

In the above-mentioned installation, lacking the power dump, the clinker grinder, etc., the firemen employ a water jet. This consists of a length of pipe open at one end to form a nozzle and connected at the other end to the water supply. When a large clinker is to be broken up, cut off is a better statement, the fireman inserts his pipe through the side door and, with the water then turned on, directs the water along the path so as to cut off the clinker. This takes only a minute to accomplish. For large furnace chambers, the water jet would be applied first from one side and then from the opposite.

The clinker is cut off cleanly along the line traveled by the water jet. The statement that this practice is foolhardy, since the brickwork will be damaged, does not hold, since the brickwork is in no way affected. The water is rapidly vaporized, and does not in any case come near any brickwork. The water jet does, however, serve a very important function, cheaply and simply.

Contracting-Construction

Washington Licensing Law—Estimating Old-House Wiring—Illuminated Level—Installing Conduit in Concrete

WASHINGTON PASSES NEW LAW LICENSING ELECTRICAL CONTRACTORS.

Law Substantially the Same as That in Oregon—No Standard Code Is Designated.

The state of Washington recently passed a law compelling contractors and others doing electrical work in the first, second and third class cities within the boundaries of that state to be licensed by the state. The licensing law reads substantially the same as that recently passed by the state of Oregon which was published in our last issue. The contractor is required to pay to the Secretary of State a fee of $15, the license to be renewed annually for the same fee, and to execute a bond of $500 as surety, conditioned to pay all damages sustained by anyone on account of failure of the contractor to comply with all laws of the state and the ordinances and building codes of the city or town in which the electrical installations are performed or against any labor or material charges.

In common with the Oregon law, the licensing feature does not apply to the construction or maintenance of lines or wires used for transmission purposes, nor for the installation of meters, etc., nor in installations in parks, on streets, alleys, etc., nor to telephone or telegraph companies, nor to those installing, maintaining or repairing apparatus or wires on the premises owned by them.

Contrary to the requirements of the Oregon law, the Code of the Bureau of Standards is not designated as the code for those cities not having local rules, no special requirements being made for these places in the new law.

Every person, firm or corporation violating or failing to comply with any of the provisions of the act are guilty of a misdemeanor.

HELPFUL HINTS ON ESTIMATING OLD HOUSE WIRING.

R. A. Le Comte Explains the Methods by Which He Secured 67 Contracts in One Month.

During the month of March, R. A. Le Comte of the Commonwealth Edison Co. of Chicago secured the wiring contracts for 67 old buildings, amounting to more than $10,000, not including the fixtures, which establishes a record for that company and probably for the country. All these buildings were located in that section of Chicago bounded by Madison and 33d streets, a district having a population of about 500,000, the great majority of whom are foreigners and which is occupied to a considerable extent by factories, warehouses, stores, railroads, etc., none of which are considered in Mr. Le Comte's territory. This was accomplished in the face of keen competition from about 500 other Chicago contractors and by means of what these contractors themselves have admitted to be fair competitive methods. His ideas on how to secure such business and his observations regarding it, therefore, should be of considerable interest to those contractors engaged in this work.

A knowledge of the latest and best wiring practices and ability to judge the prospective customer and his requirements are, in Mr. Le Comte's opinion, the greatest assets for an estimator on this work. His knowledge of wiring installations should be sufficient to enable him to assume the offensive when estimating an installation for the prospect seldom knows anything of wiring or electricity and expects the estimator to show him. In most cases, however, the estimator will find that the prospect has formed some rather decisive opinions of what he should have from other installations. Some of these may be suitable for his purposes and others may not, and the estimator must be thoroughly conversant with all methods in order that he may be able to explain, clearly, the advantages or disadvantages of each feature as applied to this particular installation. Arguments should always be avoided for the customer, while admitting his ignorance of electrical work, nearly always considers his case an exception and different from all others.

On the other hand, the estimator should exert every effort to show the customer that he is trying to assist him in securing the best installation for the least expenditure. Very often customers will request innumerable useless and extravagant features when the estimate is being made but will not accept the contract because it is too high. By pointing out the needless expense involved in these items the estimator proves he has the customer's best interests at heart and the customer in turn regards him and his estimate much more highly in return.

This does not imply that the convenience service outlet and other needed outlets should be neglected. In urging the installation of such useful features the estimator should always emphasize the fact that such conveniences can be installed much cheaper at the time the building is wired than later. However, if such features are included in the estimate, the estimator must impress this fact upon the customer, together with their advantages, in order that should some other contractor figure on the job later and not include these features, the customer will realize that the first estimate provides for these additional outlets.

Ability to anticipate and judge the requirements of a prospective customer is undoubtedly of great value to the estimator. There are many people who will resent anything but the most complete and elaborate installation. Others consider the cost only without paying any attention to the quality or quantity of the work done. Contrary to the prevailing opinion, Mr. Le Comte has found that the foreign element of his territory are the easiest and best customers. These people will save and do without many of the modern conveniences for years but when they start they want the best. There is usually some man in every such

neighborhood on whom the people rely for advice in such matters, and once the idea is sold to him he will prove a great help in securing others to accept it. On one occasion, some time ago, Mr. Le Comte, with the aid of one of these men, secured 11 contracts in one day.

The new system recently adopted by the Commonwealth Edison Co. is also partly responsible for the remarkable results which have been obtained during the last few months. According to this system, which was described in detail in our March 8 issue, the estimator is relieved of all office and miscellaneous work. He calls at the prospective customer's premises, lays out the installation with the customer and turns this information into the office. The office force makes up the estimate and proposal, which are sent in reply to every inquiry whether the prospect appears good or not. In this way the customer always has the proposal in his possession and at any time when he is so disposed may sign it and send it in before anything can happen to cause him to change his mind. By having the proposal figured and made up by the office force the estimator can devote much more time to his outside work.

The proposal as submitted is only acceptable within 30 days but even after this time it serves to remind the customer of the approximate cost and the tact that this work should be done. Furthermore, it is a very easy matter to bring the estimate up to date without having to send the estimator to the job a second time, especially if no changes or additions are required in the revised estimate.

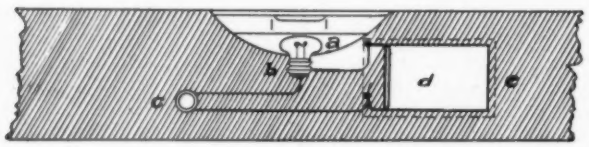
A follow-up system has also been started by which the prospects are called upon from time to time during future campaigns. At these times the estimate will be revised and a new proposal sent out.

A PRACTICAL HOME-MADE ILLUMINATED LEVEL.

By Ben R. Browne.

A useful and practical addition to a large level such as is commonly used in setting up machinery and one which is especially desirable for use in dark engine rooms and other poorly lighted places is shown in the accompanying sketch. It consists of a small pocket flashlight, the bulb of which is placed directly under the level and when turned on throws a bright light upon the marking of the level.

In the illustration, A is a little opal-backed flashlight bulb set in an ordinary pin receptacle B. From



Method of Illuminating Marker on Spirit Level.

one terminal of this receptacle a small wire is connected through a flush desk-type push switch, C, to the battery, D. The other terminal is connected directly to the battery. The level is hollowed out large enough to take the battery tightly and screws are inserted at E to make the necessary contact with the base of the battery. The hole for the battery and the channels for the connecting wires are then covered with a flat piece of brass screwed on for a cover. The outlet for the lamp and the receptacle are bored. It only requires a little care and neatness in cutting out the holes and channels to make a good job of this and its use in a few dark corners will ample repay for the little trouble it causes a good practical man to make one.

PROPER CLEARANCE FOR CONDUIT INSTALLED IN REINFORCED CONCRETE.

By W. Carver.

In installing conduit in buildings of reinforced concrete construction many electrical men make the mistake of placing the conduit tightly over the reinforcing rods regardless of whether or not these rods will be raised before the building is completed. Although some construction men raise these rods when they are placed on the forms by means of chairs or similar devices, many others lay them directly upon the forms and raise them by means of a crowbar about ½ in. when the concrete is poured to provide sufficient space for the concrete to surround the reinforcing.

In the latter case if the outlet and junction boxes have been rigidly fastened to the forms and sufficient clearance has not been left between the rods and conduit, considerable damage may be done when they are raised. This sometimes results in the conduit being torn apart or split at the couplings but more often the outlet or junction boxes are raised or displaced, causing them to become filled with concrete and set in the wrong location. In any event, the contractor or electrician working on such a building should note carefully how the reinforcing rods have been installed before "roughing-in" the job.

STATISTICS SHOW PORTION OF HOMES ELECTRICALLY LIGHTED.

National Lamp Works Also Offers Attractive Window Display for Use During Campaign.

In spite of the great progress which has been made in the past year in the wiring of old houses, the number of homes lighted by means other than electricity is still nearly double the number having electric light. It is evident, therefore, that there is still plenty of work for the contractor-dealer and the central station in equipping for electric light existing homes in areas having electric service.

According to the National Mazda *Stimulator,* there are 8,900,000 homes in this country lighted by electricity and 14,800,000 lighted by other means. A few homes in the latter class are wired but are not connected to any electric service. It is estimated that in the homes lighted by electricity there are 125,000,000 sockets containing Mazda lamps, 25,000,000 sockets containing carbon lamps and 11,000,000 empty sockets.

In order to assist in the present campaign the National Lamp Works of the General Electric Co., Cleveland, Ohio, is offering an elaborate "Electrify Your Home Now" window display. The trim consists of three pieces lithographed in three colors. One piece is a cutout of a man holding in one hand a large card bearing the campaign slogan. The other hand points to the second piece a large poster to be set in the middle background, showing a house with arrows pointing to the various rooms and listing the electrical devices which can be used in these rooms. The third piece is a slogan streamer to hang across the window.

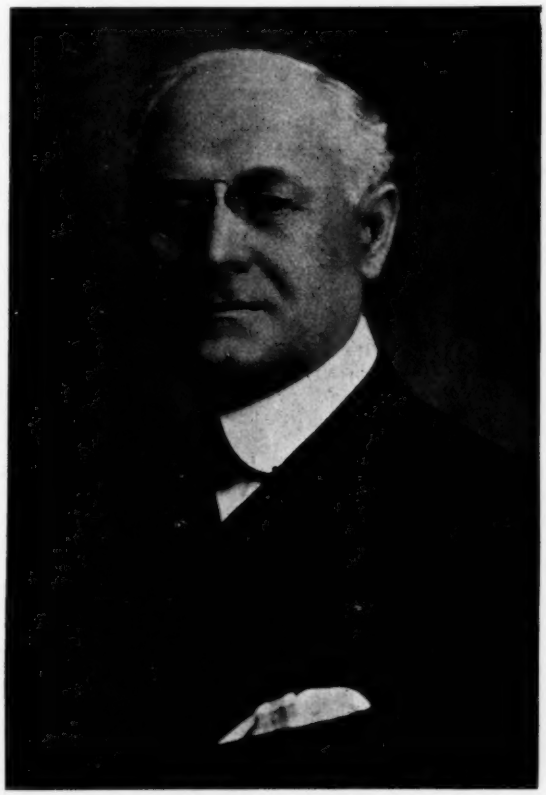
Contractor-Dealer

Contractor-Dealer's Opportunity — Steam-Laundry Men Threaten Washing-Machine Trade—How a Washer Washes

WHY ELECTRICAL CONTRACTORS SHOULD OPEN RETAIL STORES NOW.

S. A. Chase of Westinghouse Electric & Manufacturing Co. Explains Position of Contractor-Dealer.

In the work of reconstructing and improving conditions among the electrical contractors and dealers no single individual, with the possible exception of W. D. Goodwin, has been more active than Samuel A. Chase of the Westinghouse Electric & Manufacturing Co. of East Pittsburgh, Pa. As a supply salesman for this firm for many years, Mr. Chase made a host of friends in all sections of the country, gained an extensive knowledge of the contractor-dealer's methods and difficulties and formed some very valuable ideas on how to remedy and improve them. His slogan of "Live and Help Live" is growing in favor very rapidly and is typical of the man, whose earnestness and sincerity of purpose are never questioned by those that have the opportunity of hearing him. The following observations summarize the ideas expressed by him on different occasions.



Samuel Adams Chase.

The difficulties in the past have been due entirely to a lack of understanding and co-operation between the different branches of the industry. The practice of holding meetings behind closed doors, selfishness and the lack of any concentrated effort towards improvement have been largely responsible for this. During the past two years, however, a change for the better has come about. All classes now recognize and appreciate, to some extent at least, the service rendered by the other classes. The spirit of the times seems to be to get together, not only in electrical but in all industries, and this is consistent with good sound business practice and not illegal in any sense.

This brings to the electrical contractor his golden opportunity, which is to open attractive retail stores. In the past, on account of the instability of prices and the lack of help and encouragement from the other branches, only the more daring of their number could attempt this field. Now in the vast majority of cases they may open such stores confident that the manufacturer, jobber and central station will aid them in every possible way. This assistance will be supplied in a variety of forms such as: sales and advertising helps, window-display helps, attractive literature and many other methods that help to sell goods.

There is room for all in the merchandising field and all those who enter it with a desire to grow, accept and use the helps offered by the manufacturer, jobber, central station and their own National Association cannot help but find it a profitable one. This is borne out by the fact that many formerly successful contractors who became retailers for convenience rather than for profit have since entirely discontinued their contracting business. This means, however, that they should enter enthusiastically the National campaigns which are promoted from time to time, link up with the other local interests in intensive advertising and sales efforts and in inaugurating timely local campaigns and co-operate with the other dealers under the slogan "Live and Help Live." For example, a card system of difficult but possible customers may be arranged to be exchanged by the different dealers. It is a well-known fact that every salesman or every firm can not sell every customer easily, if at all, and by exchanging these prospect cards another dealer is given the opportunity of trying to sell these people. He may or may not succeed but at least the customer is not lost track of and the possibilities of an ultimate sale are greatly strengthened.

Another opportunity, in Mr. Chase's opinion, lies in improving wiring installations by installing more convenience service outlets, which will encourage a more general use of electrical household appliances. Comparatively few modern house-wiring installations are adequate or promote the use of these appliances. The difficulties and complications encountered by the housewife when she attempts to attach any electrical device to a fixture socket tends to restrict their use and only by the installation of sufficient floor, baseboard or wall outlets can this be overcome.

The field of the contractor-dealer is impregnable

and his services are now recognized as essential. On account of his apparent deficiencies in the past, the other branches have often endeavored to eliminate him but without success and now they are willing and anxious to help him make up for these few shortcomings and establish himself on a sound business basis. In order to do this however, the contractor-dealer must himself stand ready to assist by admitting his faults when they are pointed out to him, making known his requirements and making the best and most complete use of the assistance offered him. Co-operation in this way, with a little effort on the part of the various branches and strict adherence to the rule of "Live and Help Live" will in the end solve the present difficulties as they have solved many in the past and work to the advantage of all the industry.

A MENACE TO THE ELECTRICAL WASHING-MACHINE TRADE.

Steam-Laundry Men Threaten to Go After Household Laundry Business Intensively to Make Up for Losses in Other Lines.

By C. C. Johnston.

That part of an electrical store's trade embraced in articles having to do with home laundrying is likely to feel the force of a powerful effort to dislodge it. This is to come from the big steam laundries. Few people outside that industry realize what the negligee shirt with its soft cuffs and now also its soft collar has done to the laundry owner. The most profitable part of his business has been more than cut in half, and the end is not yet. The one salvation is to go after the family washing. This is fully recognized by the trade.

Otto Rice, of Chicago, president of the Laundry Owners' National Association, recently stated before a large body of his constituency, "The shirt and collar business has gone forever, as the new style shirts and the soft collars have come to stay. The whole future of the laundry business lies in obtaining the family work."

The association of which Mr. Rice is the head is an enterprising body. It has its own fire-insurance company and an advertising-writing bureau for the benefit of its members. For several years it has maintained a research department in mechanical engineering and chemistry, to promote the efficiency of plants and improve processes. It is needless to say that the association will go after the family wash trade in an intelligent and aggressive manner. At the present time a campaign is on to raise a large fund by individual contributions from all the laundry owners and members of allied industries throughout the country, so that plans may be carried forward independent of the regular association treasury.

As a starting point of their propaganda, the laundry owners frankly admit that, generally speaking, they have not deserved well of the housewife in the past. They failed to give her the painstaking service that would have won her favor. In the enjoyment of a large and rapidly growing shirt and collar trade, they looked upon family work as a cheap fill-in, until the business they had been at pains to build up in the more important line began to be swept away from them. By granting his shortcomings, the laundryman expects in a measure to soften prejudice and help clear the decks for a new deal.

Taking the country as a whole, there are many millions of dollars invested in public laundry plants and it is a question of survival with the most of them to find a new branch of activities within the industry. This will mean much change of equipment and in the aggregate a vast outlay in the effort to educate the public. As at the present time, the laundries are doing only 5% of the family work, it will be seen that the field is a promising one.

While the shoft shirt and the soft collar have partially wrecked the public laundry, they have added immeasurably to the volume of work in the home. It is estimated that what would represent two billion dollars' worth of work at public laundry prices is now done in the family. All told, there is more washing and ironing going on than ever before. The sale of household laundry equipment, a great percentage of it electrical, has made phenomenal strides. It is stated that within a recent single month 5000 domestic laundering machines of all types were sold in the city of Chicago.

As a matter of course, the laundries have no arbitrary power in securing any portion of the class of work they formerly held in light esteem, nor would public sympathy carry them very far. What they hope to do, and the object to which their association will bend ever energy, is to make the public laundry service a more attractive proposition than home work. That is the only possible way to success. Through their engineering and chemical research they expect to reach a bedrock economy of operation while attaining high perfection in the quality of work turned out.

This will be backed by a nation-wide propaganda. Surveys in different cities will be made of the home laundry-equipment situation, with the aim of showing by comparison that in the long run household laundering is less satisfactory and more expensive than public laundry service. The manufacturer of and dealer in home laundering equipment and appliances should be prepared for ingenious argument along this line which will take account of every little weakness and imperfection, as well as incident that would seem to support the laundry owner's contention.

Already there has been some gain made by the public laundry in the family field. A few plants in the larger cities, foreseeing the inevitable, made early readjustment and now have profitable, if as yet small, household following along new and approved lines. This, however, is a mere drop in the bucket compared to what the laundry owner expects to accomplish in the next few years at the expense of the home laundry-equipment trade.

Evidently the manufacturers and dealers in electric washers, mangles, ironing machines and flatirons, as well as the central stations interested in the use of energy for these appliances, should keep close tab on the situation so that no serious inroads be made on their now growing business.

HOW A WASHER WASHES.

A great many merchants have formed an incorrect idea of how an electric washer really washes. This is particularly true of the dolly-type washer, the prevailing opinion being that in this type the clothes are cleansed by rubbing against the corrugated sides of the machine. This is not the case, however, for in this as in all other types the clothes are washed by circulating the water through them, the corrugations being principally camouflage, although they do agitate the water to some extent. This was explained in a recent address by Thomas Casey, of the Hurley Machine Co., Chicago.

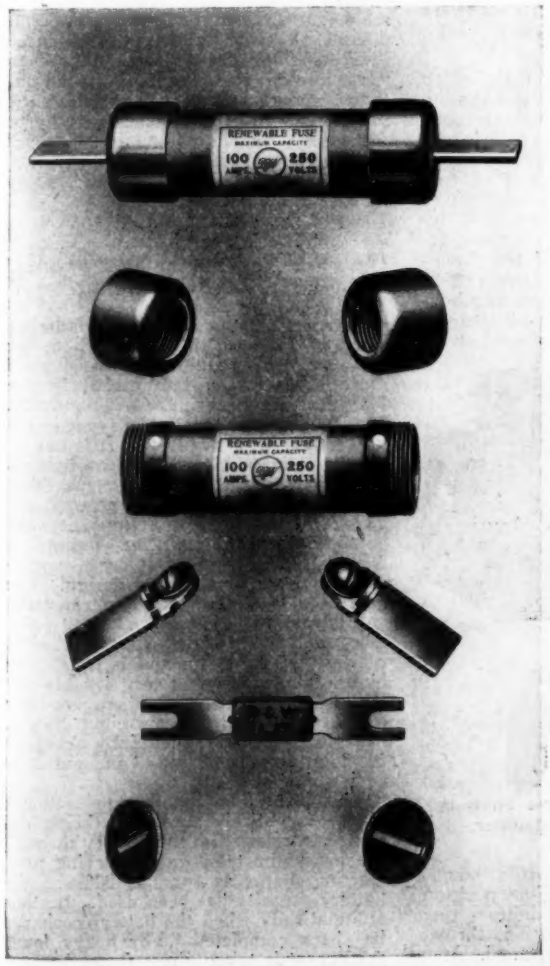
New Appliances

New Renewable Fuses—Display Cabinet—Interchangeable Sign—Automatic Coal Scale—Automatic Lighting Plants

D & W Renewable Cartridge Fuses of Knife-Blade Type.

In placing on the market last year a renewable cartridge fuse of the ferrule type the D & W Fuse Co., Providence, R. I., recognized the field for renewable fuses in certain industrial plants where motors are commonly overloaded severely, causing frequent blowing of fuses. The excellent service given by this line of D & W fuses has led the company to develop a knife-blade cartridge fuse of this type. Like the renewable ferrule type, these new fuses are built to very exacting specifications and their construction is designed to make it relatively easy to renew the fusible element properly and difficult to renew it improperly.

In fuses of this type the company believes it is essential to make the fuse casing very rugged so that it may withstand the great strain developed when the fuse blows and so it may be used over and over again without serious deterioration. The heavy fiber tubing is first reinforced by permanently fastening inner caps to both ends of the tube. These caps have slots to receive the fuse link and are designed to engage the blades and lock them in position when given a quarter turn. Asbestos-lined metal washers are then slipped over the blades to aline them properly and to regulate the escape of gas when the fuse blows. Finally the outer caps are screwed into place, engaging the threads on the outside of the inner caps, thus completing the assembly of the fuse. All end parts subject to severe strain are made of steel, which is brass-plated to prevent corrosions. The inside of inner caps is then treated to give the brass a protective coating to which the particles of the molten fuse metal will not adhere and thus interfere with easy disassembling of the fuse.



The New D & W Knife-Blade Type of Renewable Fuse Complete and Disassembled, Showing the Various Parts.

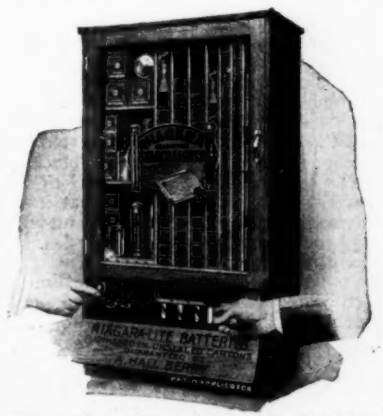
The company prides itself on having brought up this type of renewable fuse to the same high grade as its National Electrical Code standard fuses by developing a special type of fusible element, which is designated as the "expulsion" or jacketed fuse link. This link consists of a flat strip of metal with the central portion slotted and closely wrapped with a covering of specially treated asbestos. The jacket is unaffected by the high temperatures in service and remains intact even when the fuse blows on a short-circuit. When the rupture occurs an arc is formed, converting the metal within the jacket into vapor, thereby developing internal pressure within the jacket. This causes a blast of hot gases in each direction from the center of the fuse, tending to extinguish the arc. As the metal is burned back toward the terminals the jacket drops out, thus breaking up mechanically any strata of vaporized gas which might extend from one terminal of the burning link to the other and thereby positively opening the circuit.

With this design there is secured an effective expulsion action, tending to materially reduce the arc, particularly on moderate overloads, thereby securing a greater factor of safety and longer life of the casing. Another advantage of this link is its increased radiation surface, effected through the use of the jacket, which makes possible a considerable reduction in the total mass of metal required for a given current. By this means the manufacturer obtains a material lowering of the pressures developed when the fuse blows on a dead short-circuit.

D & W renewable fuses with the "expulsion" fuse links are claimed to meet the severe short-circuit tests imposed by the Underwriters' Laboratories, which subject one fuse at a time to full rated voltage at 10,000 amperes. They are made in all standard ratings from 61 to 600 amperes.

Display and Stock Cabinet for Flashlights and Their Batteries.

What is known as the "Niagara-Lite Sales Winner" cabinet, as illustrated herewith, has been recently brought out by the Niagara Searchlight Co., and is a new departure in the marketing of flashlights and batteries. This display and stock cabinet is supplied complete with battery tester fitted with lamp bulbs of proper capacity and is so arranged that each standard size of battery has its proper place. The battery stock is carried in vertical slides, new



Cabinet for Displaying and Stocking Flashlights and Batteries to Best Advantage.

stock being placed on the top, and by arrangement of spring pulls batteries are always sold from the bottom of the pile. This automatically assures that the oldest stock is first disposed of and no loss incurred from this cause.

The battery tester contained in this cabinet is novel. It is so designed that

an improper connection cannot be made, so that lamp bulbs are not burned out in testing.

Extreme care has apparently been given in working out the details of this cabinet so that it meets every need of the distributor of flashlights and batteries. The stock is kept clean and fresh. All stock is in view through the glass front and each in a particular place so that reordering can be done intelligently at a glance.

Provision is made for carrying a necessary supply of renewal lamp bulbs and searchlights as well as extra or reserve stock of batteries.

The cabinet is attractively finished in oak with nickel-plated fittings and is a sales fixture suitable for every store.

The Niagara Searchlight product is marketed by A. Hall Berry, 71-73 Murray street, New York City.

Wireless and Bushingless Interchangeable Sign.

A new type of sign representing what is said to be a radical departure in electric sign construction is about to be put on the market. This sign is in the form of the interchaneable board so popular with theaters.

Its novel feature is the fact that it does not contain a single inch of wiring nor a solitary bushing, yet it performs every function that is possible with any other interchangeable electric sign.

The absence of bushings makes for a neater appearance and the simplicity of its construction is claimed to eliminate two-thirds of the material and weight that is usually necessary of a sign of this type. At the same time, the durability and sturdiness of the sign is not sacrificed; on the contrary, it is claimed that it will outlast, with practically no expense for repairs, any of the older types of electric signs.

It is stated that this sign is the only interchangeable sign in existence that can be used with flashing effects, other than the on and off.

The wiring and bushing arrangement has been replaced by a slot formed by two pieces of specially treated angle iron. Into these slots are inserted the porcelain blocks, one for each letter to be used. Contact is completed with the letters that make up the face of the sign through pins which are inserted into contact points in the porcelain blocks.

The construction of the model of this new type of sign has shown that it can be made with one-third the material used in making up a standard interchangeable sign of the same size. The labor required is one-fourth the time to turn out the completed sign, or even less than this. In erecting, the sign itself can be handled by one man.

W. F. Keckeisen, advertising specialist, Room 1022 Harris Trust building, Chicago, Ill., is handling the sale of the patent for the owners thereof.

Reliance Automatic Coal Scale.

A coal scale for power-plant use has recently been developed by the James A. Brady Foundry Co., of Chicago. This scale is known as the Reliance automatic coal scale and for continuous weighing is claimed to be accurate within 1%. Coal comes to the scale from the overhead bunker through a pipe that is attached to a casting forming a part of the scale frame. This casting stands about 5 in. above a horizontal circular rotating disk which supports the coal in the form of a conical pile. A stationary casting above the disk serves to scrape off a certain amount of coal as the disk revolves on its axis by a motor or through a belt connection to a line-shaft. From the disk the coal falls into a cast-iron weigh hopper having vertical sides and rounded corners.

As the unit weighment is approximat-

Fig. 1.—Front View of Scale Showing Driving Gears and Motor.

ed, the balanced scale beam begins to tip down. The first part of this motion throws out the clutch driving the speed disk and stops the discharge of coal into the hopper. A sliding weight serves to compensate for the amount of coal momentarily in suspension and makes the net weight of coal actually delivered to the hopper the exact amount desired. The second part of the downward travel of the weigh hopper trips the balanced gate which serves as a hopper bottom, and the coal is all dumped out. When the last piece of coal clears

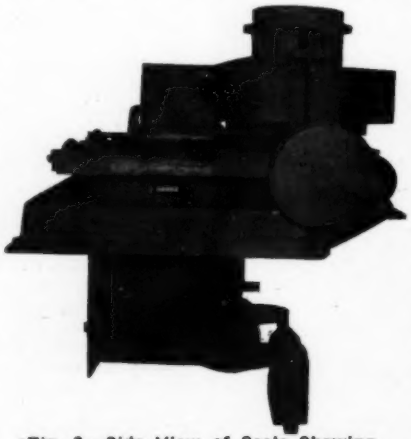


Fig. 2.—Side View of Scale Showing Hopper Bottom and Counter.

the hopper bottom, the weigh hopper starts to return to its original position. The slightly overbalanced bottom then closes, and the driving clutch is thrown in and the coal feed is resumed. It is possible to adjust the compensating weight at the second trial weighment, and when this is once adjusted the scale will continue to operate accurately as long as coal is delivered to it.

Should the chute or hopper below the scale become filled, the weigh hopper will not completely discharge and the hopper bottom will remain open as long as there is any coal resting on it. As the fireman removes the coal from the bottom of the chute, the coal will gradually work out of the hopper and when the last particle is out, the bottom will close as previously described. It takes about 10 sec. for a dump to be made, so that it is readily possible to make 100 measurements per hour, including the filling of the hopper. In ordinary operation the number of weighments will depend upon the rate of feed to the stokers, and this is automatically controlled as previously described.

The scale is of cast-iron construction throughout and has a straight-sided hopper. Hardened-steel knife-edges are housed in a cast-iron box; the dust from the coal is excluded by a felt washer. From the illustrations it will be apparent that the apparatus has a heavy frame of box section to prevent distortion of the weighing element should the scale happen to be unevenly supported. To reduce the amount of counterweight necessary and lighten the stress on the wearing parts, the ratio of the two arms of the balanced lever is four to one. The operating shaft is inclosed in a dustproof case and it is carried in ball bearings. A set of flanged wheels are attached to the scale frame when requested making it possible to roll the scale out from under the coal chute should it be desired to use it in more than one locality. An automatic counter is furnished with each scale. This may be attached directly to the frame, as shown in Fig. 2, or it may be located on the boiler-room wall where it can be seen easily and read by the boiler attendant.

Matthews' Full-Automatic Isolated Lighting Plant.

Mention was made in our issue of April 5, 1919, of the new 15-light, or 300-watt, self-contained lighting plant recently placed on the market by the Matthews Engineering Co., Sandusky, Ohio. Further particulars regarding this set are now available. It is one of the most compact sets for farm lighting or similar service ever developed. This compactness is secured through the gear-driven direct connections between engine and generator. The engine is a 2½-hp., single-cylinder, 4-cycle, water-cooled engine of standard design. The generator is of General Electric make and is rated 350 watts at 32 to 40 volts. The combined set takes up a floor space of only 20 by 48 in. and is but 30 in. high. The storage battery is a 16-cell Willard lead battery of 66-ampere-hour capacity designed to carry eight 20-watt lights for 10 hours when fully charged; its floor area is 35 by 48 in. and it is 24 in. high over all.

This plant, like the larger Matthews plants, is entirely automatic, being designed to start from the battery through the generator temporarily serving as a starting motor as soon as 20% of the battery capacity has been used. It stops automatically when the battery recharge has been completed. For heavy loads the curent is taken direct from the genertor, thus keeping the battery in good condition. A simple control panel governs the outfit.

Trade Activities

Sullivan Machinery Organizes Foreign Department — American Steam Conveyor Appoints Eastern Manager

Sullivan Machinery Co., Chicago, manufacturer of air driven and electrically driven mining and quarrying machinery, has organized a foreign trade department. F. W. Copeland, formerly connected with the St. Louis office, will be manager of the new department and will make his headquarters at Chicago.

Chicago Pneumatic Tool Co. announces the discontinuance of its office at Wichita, Kans., and the transfer of stock to Eldorado, Kans., where an office and warehouse have been established. The company also announces the opening of a new office at Tulsa, Okla., 313 Richards building, with warehouses at 102 North Cheyenne street. The new facilities will aid in better serving the increasing demands for the company's products in these territories. F. V. Sargent has been made district manager of sales in the Boston territory, succeeding F. E. Eggleston, with headquarters at 182 High street, Boston, Mass.

Crouse-Hinds Co., Syracuse, N. Y., has issued Bulletin 304 on Imperial floodlight projectors and reflectors. This is a new publication taking the place of Bulletin No. 303, and bringing up to date all of the information respecting this well-known line of floodlight projectors and reflectors. The new bulletin contains much additional information and, covering 64 pages, is probably the most complete publication on floodlight projectors and flood-lighting. These projectors are made in two types, SD for projecting concentrating beams to considerable distances, and type SC for projecting broad beams to shorter distances. The difference between these two types is carefully explained and the numerous forms of each type are described in much detail. Diagrams are shown of the characteristic spread of these different types, and typical floodlight calculations are worked out to show how any particular problem can be solved. In connection with the description of the individual types there are both halftone and dimensional illustrations and full details are given regarding not only construction but the particular applicability of each type. There are many large illustrations, mostly full page size, showing installations of the different types and thus giving an excellent idea of the variety of purposes for which flood-lighting can be employed advantageously and also definite suggestions for methods of mounting. These illustrations show only cases where such projectors are used for industrial purposes, and do not include the many cases where they are employed for advertising or display service. The latter part of the bulletin is devoted to types RM and RS Imperial reflectors, which have been designed especially for use in lighting up the stalls of locomotive roundhouses. This is a very difficult problem in lighting and has been solved very satisfactorily by the use of these two types of reflectors. A number of halftone and diagrammatic illustrations are shown of such installations, also views in which these reflectors are used for other railroad and dock service.

The Bailey Meter Co. will move its main office and works from Boston to Cleveland, Ohio, effective May 1. The Boston office, with H. D. Fisher as manager, is retained to handle sales and engineering service work in the New England district. For the present New York and Philadelphia districts will be covered from Boston and all other districts will be covered from Cleveland.

Hamilton & Hansell, 13 Park Row, New York, agents for the Rennerfelt electric furnace, have sold two furnaces, one of one-ton capacity to the Liberty Steel Corporation, Morristown, N. Y., for making tool steel, and the other a 1200-lb. furnace to the American Metallurgical Corporation, Conshohocken, Pa. This furnace will be operated jointly by the latter company and Hamilton & Hansell in experimental and research work.

The American Steam Conveyor Corporation, Chicago, announces the appointment of Charles H. Florandin, formerly of the National Electric & Welding Co., New York, as general manager of its eastern territory with headquarters at its New York office, 110 West 40th street. Mr. Florandin, who assumes charge of his new duties May 1, was born in France and received his technical education at the famous Lycee de Marseilles. He is an engineer by profession and upon coming to the United States did important work with the Brooklyn City Railway Co. in the early days when the road was being electrified. After five years' service with this company he joined the C & C Electric Co., New York, where he held a responsible position with them for many years. After a brief connection with the Western Electric Co. he returned to the C & C Electric Co. and later organized the National Electric & Welding Co. During the war Mr. Florandin was a member of the Welding Committee of the Emergency Fleet Corporation and here did valuable work for our country. The sound engineering knowledge and extensive acquaintance of Mr. Florandin among consulting engineers and power plant executives makes him a valuable acquisition to the American Steam Conveyor Corporation's organization.

MacGovern & Co., Inc., 114 Liberty street, New York City, has issued a 16-page booklet listing turbo-units, reciprocating units, condenser equipments, motor-generator sets and rotary converters.

The 1900 Washer Co., Binghamton, is doubling the capacity of its plant, which will be completely electrified. The present capacity of the plant is 100 washing machines per day, which number will be increased to 200 per day. The possibilities for enlarging the plant are very great, owing to the extraordinarily heavy demand for its particular type of machine. The 1900 Washer Co. is one of the oldest concerns of the kind in the United States.

Electric Products Co., Cleveland, Ohio, manufacturer of battery charging motor-generators and rheostats, vehicle motors and controllers, etc., announces the return to its sales ranks of Capt. J. P. Lyons, recently returned from 18 months' service in France. Mr. Lyons will be district sales manager for New England, with temporary headquarters at the New York office of the Electric Products Co., 1328 Woolworth building.

Allis-Chalmers Manufacturing Co., at Seattle, Wash., has closed a contract for a 10-in. suction, 8-in. discharge, two-stage centrifugal pumping unit for the municipal water works of Olympia, Wash. Both pump and motor are of Allis-Chalmers make, the motor being a 100-hp., 60-cycle, three-phase, 440-volt and will deliver 1150 gal. a minute against a head of 235 ft. The unit will be supplied with a flexible coupling mounted on an extension to the pump shaft opposite the motor so that a steam turbine can be direct connected at some future time. A switchboard controlling the equipment is also furnished. It is expected that the unit will be in operation in July.

International Earth Boring Machine Co., 10 South La Salle street, Chicago, is distributing a very attractive circular which has for its subject earth-boring machinery versus hand labor. It is profusely illustrated, showing the wide range of application of this machinery, and contains a detailed description of the equipment. The International Earth Boring Machine Co. is one of the most comprehensive designers and manufacturers of mechanical and practical earth-boring machinery in the world. Each unit and device of the company is fully tested and patented in the United States and Canada, with patents also pending in England, France, Belgium, Switzerland, Sweden, Norway, Denmark, Australia, Argentine Republic, Brazil, Chile and Japan.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

Claremont, N. H.—Shipment has been made of a new generator for the Claremont Power Co. This generator will be direct connected to the water wheels, doing away with a considerable amount of shafting and belting.

Springfield, Vt.—Colonial Power & Light Co. has been awarded a contract by the Springfield Brass Co. for supplying additional electric energy to practically double the capacity of its plant. The Springfield company is considering plans for the installation of a new electric furnace to be used for melting brass in its foundry.

Spencer, Mass.—Work has recently been completed on extensive alterations and improvements in the power plant at the works of Isaac Prouty & Co. Arrangements have been made that a quick shift can be effected to 24-hour electrical service if necessary.

Warren, Mass.—Warren Steam Pump Co. has awarded a contract to the William Fullam Co., North Brookfield, for the erection of the proposed new extensions at its plant. The work includes the construction of a boiler plant and pumping building, addition to the main shop, and other additions.

Putnam, Conn.—Nightingale-Morse Mills, Inc., has completed arrangements for the construction of a hydroelectric plant to supply electricity to the mills.

Providence, R. I.—U. S. Electric Co., 30 North Main street, has filed notice of organization to manufacture electrical goods. Simon Yaraus, 2 Pratt street, heads the company.

Binghamton, N. Y.—Considerable new electrical equipment will be required in connection with the proposed construction of the local Majestic Theater, estimated to cost approximately $250,000, having a seating capacity of 2000. It is understood that electric service will be furnished by the Binghamton Light, Heat & Power Co.

Bridgeburg, N. Y.—Plans are under consideration by the town council for the installation of new equipment at the municipal pumping station, including a new electrically-operated pumping unit, to increase the present capacity of the works.

Gloversville, N. Y.—Plans are being prepared by the Kingsboro Silk Mills for the construction of a two-story factory and boiler plant addition to their works, about 40x100 ft. The structures are estimated to cost $20,000, and will be located on Glenmont avenue. L. E. Winnie is secretary.

Long Island City, N. Y.—In connection with the proposed construction of a large plant by the American Chicle Co., to be located on property bounded by Thompson avenue, Mount street, Manley street and Nott avenue, about 200x600 ft., estimated to cost in excess of $1,000,000, considerable electrical equipment will be required. It is proposed to install a large fire pumping unit to have a capacity of 1000 gal. per minute in the power plant.

New York, N. Y.—United Electric Light & Power Co., 130 East 15th street, has completed foundation work for the construction of its proposed transformer building at 201st street and the Harlem river, estimated to cost $16,000. The Louis Weber Building Co., 171 Madison avenue, is the contractor.

New York, N. Y.—In connection with the ten-story building now in course of erection by the Pictorial Review Co. at 39th street and 7th avenue, contract for supplying electric power service has been awarded to the New York Edison Co. It is understood that 800 hp. in motors will be required, while for lighting service a total of about 3000 incandescent lamps will be used.

New York, N. Y.—In view of anticipated building activities in outlying districts during the present year, the Public Service Commission has required all gas companies and electric concerns to file schedules showing on what terms and conditions they will extend their systems to streets and sections not now supplied with gas and electricity.

New York, N. Y.—It is interesting to note that a total of 937,118,423 kw. were utilized by consumers of electric current in New York City during the last fiscal year, at an estimated cost of $40,802,469. This latter figure is an increase of $2,100,000 over the revenue for the same period during 1917.

New York, N. Y.—Central & South American Telegraph Co., 66 Broadway, has made announcement that the necessary cable for a connection between Buenos Aires and the City of Montevideo in Uruguay has been purchased, and it is expected that the work will be completed by July 1. The company recently announced that the capacity of its cables has been increased by approximately 70% by the installation of new instruments and automatic devices.

Niagara Falls, N. Y.—Star Electrode Works have recently broken ground for the construction of a one-story factory addition to their plant, about 25x67 ft., to provide for increased capacity. Braas Brothers, Whitney avenue, are the contractors.

Syracuse, N. Y.—L. W. Kiesewetter, 632 North Salina street, has recently completed the installation of electric motors, generators, switchboards, etc., in the plant of the Werner Macaroni Co.

Camden, N. J.—Wilckes, Martin & Wilckes, manufacturers of lamp black, etc., have completed plans for the erection of a new two-story calcine building at their plant. Frank Sutton, 80 Broadway, New York, is engineer for the company.

Hillside, N. J.—Town council is understood to be considering plans for extensions in the present electric street lighting system.

Jersey City, N. J.—Junction Electric Co. has filed notice of organization to operate at 492 Communipaw avenue for the manufacture of electric supplies. Fred Lawin, 99 Monticello avenue, heads the company.

Newark, N. J.—The Board of Commissioners has recently passed an ordinance providing for the establishment of an Electrical Bureau of the Department of Public Safety. W. J. Egan is city clerk.

Newark, N. J.—Brown-Hunkele Corp., 12 Mechanic street, manufacturer of motors, etc., has filed notice of an increase in its capitalization from $30,000 to $100,000, to provide for general business expansion.

Wanaque, N. J.—It is understood that a new local corporation is now in process of formation which proposes to construct a new transmission line from Pompton Lakes to Wanaque for the purpose of purchasing electric energy from the municipal authorities at the former location and distributing to local and neighborhood sections.

Erie, Pa.—Lake Erie Welding & Spring Co. has completed plans for a factory, 30x100 ft. in dimensions. New equipment will be required, including a five-ton hoist.

Philadelphia, Pa.—Lester Piano Co., 1306 Chestnut street, has arranged plans for the installation of new electrical equipment in its plant, including alternating-current unit, 500 kw., non-condensing, revolving-field, two-phase, 60-cycle, 220 volt, and other apparatus.

Pittsburgh, Pa.—Pittsburgh Model Engine Co. has awarded a contract to the Austin Co., Cleveland, Ohio, for the construction of additions to its plant at Point Breeze, to comprise a new two-story factory addition, and one-story factory building, about 60x320 ft., and 40x160 ft., respectively, and an addition to the office building, with auxiliary structures, the entire work to represent an investment of about $200,000.

Sayre, Pa.—Sayre Electric Co. is extending its line into East Athens where it has secured about twenty-five customers.

York Haven, Pa.—York Haven Water & Power Co. is considering plans for improvements and alterations in its local plant to facilitate operations. Gannett, Seely & Fleming, 204 Locust street, Harrisburg, are consulting engineers.

Charlestown, W. Va.—Northern Virginia Power Co. has commenced the extension of its lines from its plant on the Shenandoah river to Millville, a distance of about one and one-half miles.

South Charleston, W. Va.—West Virginia Water & Electric Co. has made application for permission to construct a new electric light system in South Charleston. Headquarters of the company are at Charleston.

Spencer, W. Va.—W. S. King proposes to establish immediately a machine shop and boilers works in a two-story building, 50x120 ft., the initial cost of which is to be about $8000. Machinery for all departments will be installed, including steel tank production, boiler repairs, etc.

Greenville, N. C.—$50,000 light and water bonds has been authorized by vote. Address Albion Dunn, mayor.

Tuxedo, N. C.—Blue Ridge Power Co. is making rapid progress on the construction of its new dam and power plant, and is going ahead with arrangements for the proposed construction of new transmission lines, to extend to Spartanburg. The entire project is estimated to cost in the neighborhood of $1,000,000. W. A. Montgomery is president; Mess & Mess, Charlotte, are consulting engineers for the company.

Miami Fla.—Miami Electric Co. will receive bids in summer for enlarging its plant, thereby increasing its capacity about 150%. C. W. Murray, city engineer.

Pensacola, Fla.—The Navy Department has completed arrangements for the installation of new electrical equipment at its local station.

Perce, Fla.—American Agricultural Chemical Co. has awarded a contract to G. A. Miller, Tampa, for the construction of a steam turbine power plant at its works for operation.

NORTH CENTRAL STATES.

Alliance, Ohio.—Alliance has voted to issue bonds for a municipal electric light plant. Address city clerk.

Berlin Heights, Ohio.—The Combined Lake Shore Electric Railway subpower station and waiting room have been destroyed by fire. Loss, $15,000. Two big dynamos were put out of commission. The structure will be rebuilt at once and new equipment installed. Address E. W. Moore, president, Cleveland, Ohio.

Cleveland, Ohio.—Van Dorn Electric Co., 2978 Woodhill road, will erect a $40,000 factory; $60,000 will be expended for lathes, drills, pumps and dynamos. Contracts will be let by Architect W. Hatler, 723 Illuminating building.

DATES AHEAD.

Pacific Coast Section, N. E. L. A., Pacific Division, National Electrical Jobbers' Association and California Association of Electrical Contractors and Dealers. Joint convention, Coronado, Cal., April 30 to May 2.

National Fire Protection Association. Annual meeting, Ottawa, Ont., May 6-8. Secretary-treasurer, Franklin H. Wentworth, 87 Milk street, Boston, Mass.

Southwestern Electrical and Gas Association. Annual convention, Galveston, Tex., May 12, 13 and 14. Headquarters, Hotel Galvez. Secretary, H. S. Cooper, 403-404 Slaughter building, Dallas, Tex.

American Association of Engineers. Annual meeting, Chicago, Ill., May 13-14. Secretary, C. E. Drayer, 29 South La Salle street, Chicago, Ill.

National Electric Light Association. Annual convention, Atlantic City, N. J., May 19-23. Secretary, T. C. Martin, 33 West 39th street, New York City.

Illinois Association of Electrical Contractors and Dealers. Summer convention, Decatur, Ill., June. Secretary, N. M. Blumenthal, 179 West Washington street, Chicago.

Electrical Supply Jobbers' Association. Annual convention, Hot Springs, Va., June 10, 11 and 12. Headquarters, The Homestead Hotel. Secretary, Franklin Overbagh, 411 South Clinton street, Chicago.

Tri-State Water and Light Association. Annual convention, Greenwood, S. C., June 17-19. Secretary-treasurer, W. F. Stieglitz, Columbia, S. C.

American Society of Mechanical Engineers. Spring meeting, Hotel Statler, Detroit, Mich., June 17-20. Secretary, Calvin W. Rice, 29 West 39th street, New York City.

American Institute of Chemical Engineers. Summer meeting, Boston, Mass., June 18-21. Secretary, Prof. J. C. Olsen, Polytechnic Institute, Brooklyn, N. Y.

American Institute of Electrical Engineers. Annual convention, June 24-27, Adirondacks, N. Y. Headquarters, Lake Placid Club. Secretary, F. L. Hutchinson, 33 West 39th street, New York.

National Association of Electrical Contractors and Dealers. Annual convention, Milwaukee, Wis., July 15, 16 and 17. General manager, William H. Morton, 110 West 40th street, New York City.

Ohio Electric Light Association. Annual meeting, Cedar Point, Ohio, July 15-18. Headquarters, Breakers Hotel. Secretary, D. L. Gaskill, Greenville, Ohio.

Association of Iron and Steel Electrical Engineers. Annual convention, St. Louis, Mo., September, 1919. Secretary, John F. Kelly, Empire building, Pittsburgh, Pa.

Damascus, Ohio.—The question of establishing municipal lighting is under consideration. Address village clerk.

Lima, Ohio.—The city is considering improving lighting system; $56,000 of the old fund remains. With the installation of another boiler at the waterworks plant the city will have enough generating power to furnish current for an elaborate street lighting system. The matter of the city installing electrical wiring system is a problem of expense. Address W. J. Dempster, president of council discovered.

Lorain, Ohio.—Cromwell Steel Co., J. C. Cromwell, Guardian building, Cleveland, Ohio, will purchase new motors, generators, table rolls, rolling mill equipment, electric and flying sheers, 5 to 10-ton cranes, etc. Cost $200,000.

Mansfield, Ohio.—Kenney Co. has increased its output and has increased capital stock from $20,000 to $100,000. The company will install new electrical machinery and machine shop equipment. Address Jacob Cousins, treasurer, Mansfield.

Bluffton, Ind.—The commissioners of Wells county have granted a franchise to the Linn Grove Light & Power Co. to construct a line from Riverside to Craigville, to light the latter named towns and to supply intermediate territory with current. The commissioners also authorized the Union Township Electric Co. to extend a line from Uniondale to prospect in order to secure current from the Fort Wayne and Northern Indiana Traction Co.

Evansville, Ind.—Hedderich Brothers, owners of the Evansville brass foundry, will erect a new foundry building, 50x100x30 ft., one story, with metal sash.

Hartford City, Ind.—It is said that the Pennsylvania Railroad will erect a $45,000 station in this city.

Terre Haute, Ind.—Terre Haute Labor Temple Association has announced plans for building a labor temple, four stories, with auditorium seating 150,000, to cost $150,000.

Bement, Ill.—Residents of Bement and Ivessale have petitioned the Bement Electric Light & Power Co. asking that the company give 24-hour service in the towns named.

Decatur, Ill.—A. E. Staley Co. will erect factory building, brick and concrete, 221x130 ft. to cost $70,000.

East St. Louis, Ill.—Jesse I. Gedney, East St. Louis contractor, has been awarded the contract for building the Gillespie, Ill., schoolhouse for $110,000.

Evansville, Ill.—A new factory building to cost $35,000 will be erected by a new company composed of members of the Advance, the Southern, the Crescent, and the Indiana stove companies. The new company will do enameling of stove parts for all the four named companies.

Pana, Ill.—Pana Engine & Manufacturing Co. has applied to the state auditor for a charter to organize with capital of $60,000. The company proposes to manufacture steam engines. Address C. A. Andrews.

Peoria, Ill.—Illinois Traction System has petitioned the Illinois Public Utilities Commission for authority to increase its rates 10 to 15%. The present rate is 6 to 15 cents per kw.-hr. for power supplied to grain elevators and to farmers.

Litchfield, Ill.—It is said that the Studebaker Corporation, with offices at South Bend, Ind., may soon become the owners of the Southern Illinois Light & Power Co., a $2,000,000 corporation, if plans now under consideration for the transfer are carried out. The Studebaker Corporation owns power plants in Oklahoma, Michigan and various other states, but the transfer will result in its first property in Illinois. The Southern

Illinois Light & Power Co. furnishes light to the majority of the towns in the southern part of the state of Illinois.

Little York, Ill.—The electric light plant of Little York was destroyed by fire with loss of $2000. The plant is owned by F. Pardee of Little York.

Mattoon, Ill.—Central Illinois Public Service Co., of this city, has filed a petition with the Illinois Public Utilities Commission asking for authority to build and operate a transmission line to furnish electric light, heat and power to New Berlin.

Peoria, Ill.—The Illinois Traction System has filed a petition with the Illinois Public Utilities Commission asking for authority to increase electric power service to the large number of cities and towns which it serves along its lines. The petition is filed in the name of the Bloomington, Decatur & Champaign Railroad Co., the Illinois Central Traction System, the Danville, Urbana & Champaign Railway Co., and the St. Louis, Springfield & Peoria Railroad Co.

Quincy, Ill.—New machinery is being installed at the power house of the Quincy Railway Co. in order to use Keokuk power and to permit the steam plant to stand idle for emergencies, thus making a double power plant. The company is adding new cars to the equipment and the service will be generally improved. The most important machinery being installed at the power house is a motor generator of large size.

Detroit, Mich.—B. & H. Machine Products Co. has under advisement the erection of new works to replace its plant recently destroyed by fire. The loss is estimated in excess of $10,000.

Detroit, Mich.—Detroit Edison Co. has under consideration the construction of an addition to its Delray power plant, increasing the output by 30,000 kw.

Howell, Mich.—Detroit Edison Co. has purchased a site for a power plant to be built, at an estimated cost of $50,000. This station will furnish power for Howell industrial plants. Address general manager, David Whitney building, Detroit.

Ladysmith, Wis. — $4000 lighting bonds have been authorized by the council.

North Freedom, Wis.—North Freedom Canning Co. contemplates the erection of a plant to include a one-story boiler house and steam generating plant to cost about $50,000. G. Shore, manager.

Atlantic. Iowa.—David G. Fisher & Co., engineers, 206 East 4th street, Davenport, Iowa, have been awarded the general contract for municipal power plant addition. Estimated cost, $30,000.

Des Moines, Iowa.—A new apartment hotel building will be erected by J. W. Gregory, to cost $500,000. The building will contain 85 apartments, will be nine stories high, 56x96 ft.

Dubuque, Iowa.—Dubuque Electric Co. is carrying some excellent publicity matter in the papers of that city, urging people to wire their houses during the spring months. The company is making a special price of $3.31 a month for 12 months payments to include the wiring of five principal rooms, complete with fixtures, shades, lamps and meter connections. Dubuque Electric Co. includes the name of the five following contractors as co-operators in the advertising matter: Keller Electric Co., Appels' Electric Shop, E. P. Smith Electric Co., and the Schmid-Lowe Electric Co.

Dubuque, Iowa.—Dubuque will vote on the question of municipal ownership of a light and power plant to cost $500,000. The issue will also include the erection of a new city hall to cost $400,000 and the sum of $250,000 to provide for construction work for the board of education.

Knoxville, Iowa.—Fire recently destroyed the plant and office of the Marion County Electric Co., with a loss estimated at about $13,000. It is understood that plans are under consideration for rebuilding.

Traer, Iowa.—The town, which is getting its electric current from a high-tension line, is considering municipal ownership, and contemplates either purchasing the equipment already in the city or building a new modern plant.

Carrollton, Mo.—Brunswick Light & Water Co. is preparing to run an extension line of its electric service to Triplett and manager L. A. Nickell expects to have the work under way soon.

Kansas City, Mo.—The park board has asked the mayor and city council to appropriate $100,000 for improvements to Swope Park. It is planned to install a complete lighting system.

Kansas City, Mo.—The Manoir Frontenac, a new 13-story residential apartment building, to contain 103 completely furnished apartments, will be erected at a cost of $700,000, including the site worth $100,000. The building will be 80x183 ft. and will include several small shops, a restaurant and garage facilities for tenants. The company organized to build the Manoir Frontenac has been named the Boulevard Investment & Realty Corporation.

St. Joseph, Mo.—Arrangements have been completed to begin work on the addition of a 10,000-kw. unit to the power plant of the St. Joseph Railway, Light, Heat & Power Co. The additional unit will be so constructed that it can be operated independently of the present plant. When completed it will give the company a 20,000-kw. plant. The present plant will not be remodeled.

St. Joseph, Mo.—An election is contemplated for May 27 to vote on $500,000 in bonds for extension to the light plant. Archer & Stevens, New England building, Kansas City, Mo., engineers. J. P. Gates, city clerk.

Kansas City, Kans.—The Commissioners of Kansas City, Kans., have designated June 17 as the date for holding the special election to vote on issuing $500,000 of bonds for funds to enlarge the municipal light plant. The present capacity of the plant is taxed and additions in both housing facilities and equipment is needed.

Oswego, Kans.—Election to vote $50,000 bonds for the erection of an electric light plant carried.

St. John, Kans.—Election to vote $45,000 bonds to improve the water and light system by equipping a power plant, carried.

Scranton, Kans.—Election to vote $12,000 for the construction of a transmission line to carry electric current from the corporate limits of Burlingame to Scranton, carried. The plans provide for lines, wiring and appliances to be constructed and used for furnishing the city of Scranton with electric lights.

Sedan, Kans.—Sedan Electric Light & Power Co. is planning an extension of its plant. Transmission lines will be constructed to Peru, Chatauqua and Elgin, with extension of power plant sufficient to meet future requirements of the lines. The plans contemplate installation of fuel oil motive power. Estimated cost, $32,000.

Turner, Kans.—Standard Electric Co. will supply current for electric lights and power for Turner. Address J. J. Swigley, Turner, Kans.

Holdrege, Neb.—Election to vote $68,000 in bonds for an electric light plant, carried recently. W. Lindstrom, city clerk.

Omaha, Neb.—Skinner Packing Co. will erect wholesale branch house, eight stories, reinforced concrete construction, 99x132 ft.

Vermilion, S. D.—An election will be held to decide the question of issuing $60,000 in bonds for electric lighting plant.

Fargo, N. D.—$150,000 in bonds has been voted for municipal electric light and power plant.

SOUTH CENTRAL STATES.

Smithland, Ky.—Smithland Light & Power Co., recently incorporated, has awarded a contract to the Home Electric Supply Co., Paducah, for the construction of a local plant. C. H. Wilson is president.

Chattanooga, Tenn.—Chattanooga Railway & Light Co. is considering plans for the rebuilding of its power station and passenger station at the head of Lookout Mountain incline, recently destroyed by fire, with loss estimated at $50,000.

Harriman, Tenn.—Coalfield Coal Co.'s power house burned recently with a loss of $20,000. Electrical equipment was destroyed.

Nashville, Tenn.—The city is planning for the installation of new boiler equipment in the municipal electric light plant. Bonds to the amount of $60,000 will be voted to provide for the cost of the work.

Cotter, Ark.—Walker V. Powell of Little Rock, president of the Dixie Power Co., proposes to install an hydroelectric plant on the White river here. Mr. Powell and F. B. Clemens, representing Hugh L. Cooper engineering firm of New York, have been

investigating the water power resources in this section.

Jonesboro, Ark.—Plans are under way for a white way on Union street from Court square to Burke avenue, north. A committee of real estate owners have been appointed to confer with the electric light and water company on a cost estimate.

Grove, Okla.—Plans are being made to improve both the municipal light and water plants, which are inadequate to supply the increasing demands.

Newkirk, Okla.—The city commissioners are now working on plans to extend the water and light system. When all reports are in the city engineer will submit an estimate and bonds will be voted.

Pawhuska, Okla.—Extensive improvements in the municipal power plant are being planned. It is understood that bonds for $250,000 will be issued to provide for the work.

Tishomingo, Okla.—Election to vote $50,000 bonds for the construction of an electric light plant, carried.

Fort Worth, Tex.—Of the $1,890,000 bond issue voted recently, $50,000 of the amount will be used for the extension and improvement of the lighting system.

Higgins, Tex.—The city council recently closed a contract with C. L. Tennison, to install an electric light plant. The contract calls for a first class modern plant and work will begin in the near future.

Paducah, Tex.—Election will be held in the near future to vote bonds for an electric light and ice plant.

Pilger, Tex.—Petitions have been circulated for a new lighting system.

San Angelo, Tex.—Mayor R. H. Henderson and City Manager E. L. Weels, Jr., have been authorized by the city commission to open negotiations with the San Angelo Water, Light & Power Co. for the purchase of the local property of the Interstate Electric Corporation of New York.

Stamford, Tex.—Plans are being prepared by the city for waterworks improvements to include concrete dam with turbine engines, reservoir 200 ft. wide, 10 ft. deep and 1 mile long, to cost about $400,000.

WESTERN STATES.

Butte, Mont.—The Council will extend lighting system. Address city clerk.

Kalispell, Mont.—Mountain States Power Co. has received a 35 months' street-lighting contract from the city council, providing for the establishment of a number of new lighting districts. A rate of $3.35 per month for clusters of four 60-watt lamps has been adopted.

Missoula, Mont.—Engineers have been engaged by the Missoula Light & Water Co. for the purpose of having plans perfected for sluice gates at the company dam near Bonner, estimated cost $50,000.

Whitefish, Mont.—The City Council is considering plans for the installation of a municipal electric power plant with local distributing system. A committee has been appointed to investigate the proposition and prepare estimates of cost, etc.

Pueblo, Colo.—Arkansas Valley Railway, Light & Power Co. will serve the Pope Block with 100 hp. of electrical energy covering its entire lighting and power requirements. The private plant which has formerly operated in this building will be abandoned. The company has completed an installation of 20 250-watt Mazda street lamps in Minnequa Heights, one of Pueblo's suburbs.

Helper, Utah.—The City Council is considering plans for the rebuilding of the penstock and intake works at the hydroelectric power plant, destroyed by flood recently. The work is estimated to cost about $10,000.

Wallace, Idaho.—Power plant of the Federal Mining & Smelting Company near Upper Burke burned, causing a loss of about $20,000.

Raymond, Wash.—O. C. Fenalson, Portland, Ore., has taken over the plant of the Pacific Wood Package Co., and will make important changes in the plant, including the installation of considerable new equipment.

Seattle, Wash.—A warehouse, 220x56 ft., will be constructed by Stone & Webster, Stuart building, as a cost of $15,000, for storing the machinery and equipment owned by the Puget Sound Traction, Light & Power Co., not taken over when the city purchased the street car system. The roof of the building will be supported by heavy-timbered trusses.

Seattle, Wash.—The city will make extensive additions to light and power system; $750,000 in bonds will be available for the purpose.

Seattle, Wash.—Equipment for the trans-Siberian railroad, amounting to 69,000 tons, is now being moved from Seattle to Vladivostok under shipping contracts lately awarded in New York. This equipment was purchased two years ago and has been held in Seattle during that period by reason of unsettled conditions. It comprises locomotives, rails, knockdown cars, and other material. It is reported here that this material is being shipped at a rate of $21 per ton.

Seattle, Wash.—The city is to add extensively to its light and power system in the near future. New lines will be constructed for the purpose of street lighting and furnishing light and power to business and residence districts. A large part of the funds will be used to prepare for the additional current coming from the Cedar river plant and the Skagit. The substation at Ballard will be equipped, also the industrial substation on Spokane street and tie-lines will be constructed covering substations. The plan to be ultimately carried through is to bring the Cedar river current to the Spokane street substation on Spokane street instead of the substation at 7th avenue and Yesler Way which will become a distinct station with a lower voltage for the main business section. Proceeds from the sale of $750,000 utility bonds will be available within a few days for this purpose.

Selah, Wash.—Pacific Power & Light Co., Portland, Ore., is arranging for the construction of a 6600-volt, single-phase distributing system to serve a large block of ranch property to the east of this community.

Spokane, Wash.—All the property rights and franchises of the Spokane Heat, Light & Power Co. once valued at more than $2,000,000 will be sold at the plant on April 21.

Wenatchee, Wash.—W. L. Chrysler, of Wilbur, has bought out the Root Electric Co., formerly owned by Jose & Downey, and will conduct the business in the future.

Yakima, Wash.—N. C. Richards, president of the Yakima Valley Transportation Co., Yakima, Wash., has filed with the public service commission an amended schedule of street car fares for the city passenger lines, providing for a 10-cent fare, with the possibility of buying tickets for 8 cents and a school children's rate of 4 cents. This is practically 100% of increase over the rates now charged. F. D. Ridley, accountant for the public service commission submitted figures to show that the company had a deficit on its lines of $32,927 last year. He proposed that the city take over the lines and operate them; but the city commission declined to do this.

Marshfield, Ore.—Mountain States Power Co., Marshfield division, has closed a contract with the Johnson Lumber Co. at Coquille, Ore., for 150 hp. in motors. This is in addition to the present power installation of the company which expects to install additional motors in the near future.

North Bend, Ore.—Mountain States Power Co. is considering plans for the removal of its power plant from Marshfield to North Bend, with installation of additional equipment at the new location to provide for increase in generating capacity.

Fresno, Cal.—A power plant for works operation will be erected by the California Packing Corp. in connection with its local packing plant. Electric motors and mechanical equipment will also be installed in different departments of the plant for operation. The entire plant is estimated to cost about $200,000.

Hermosa Beach, Cal.—Electrically operated pumping machinery and auxiliary equipment will be required for the proposed new municipal waterworks system, now being planned by the board of city trustees. The plant is estimated to cost about $100,000. Benjamin Brown is city clerk.

Los Angeles, Cal.—A new electric generator department and electrical shop building will be erected at the motion picture plant of the Clune's Production Co., 5350 Melrose avenue.

Los Angeles, Cal.—The City Council has authorized the construction of an ornamental lighting system on Westmoreland place, between 7th street and Wilshire boulevard.

Los Angeles, Cal.—F. E. Newbery Co. has been awarded a contract for electrical work, including special lighting, etc., at the establishment of the C. H. Baker Shoe Co., 451 South Broadway.

INCORPORATIONS

Houston, Texas.—Houston-Guadeloupe Water Power Co. has been chartered with $200,000 capital stock by H. A. Halverton, F. T. Beadle, C. H. Kolbe and others.

Vinton, Ia.—First Eden Light Co. has incorporated with a capital of $10,000. W. C. Kray, president.

New York, N. Y.—Swiss Anode Corporation. Capital, $100,000. To engage in the manufacture of anodes. Incorporators: O. C. Martin, C. R. Dean and L. J. Auerbacher, 13 Park Row.

New York, N. Y.—Girtanner Engineering Corporation. Capital, $50,000. To manufacture boiler house equipment, ash conveyors, and other equipment. Incorporators: F. A. Salmon, M. F. Carney and P. S. Lane, 633 East 16th street, New York.

Brooklyn, N. Y.—Farraday Electrical Corporation. Capital $20,000. To manufacture electrical specialties. Incorporators: L. Goldbaum, L. Snitkoff and B. P. Nussbaum, 2029 Surf avenue.

New York, N. Y.—Own Flashlight Co. Capital, $10,000. To manufacture electric lamps, etc. Incorporators: M. J. and M. Frenan, and J. Rudges, 1981 Prospect avenue.

New York, N. Y.—Munier & Wolff, Inc. Capital, $20,000. To engage as electrical and heating engineers. Incorporators: L. L. Munier, R. A. and H. A. Wolff, 2 Rector street.

New York, N. Y.—Perfect Refillable Fuse, Inc. Capital, $50,000. To manufacture fuses, etc. Incorporators: H. Vantwistern, W. F. Muller, and A. A. Sarafan, 140 Nassau street.

Troutman, N. C.—Troutman Light & Power Co. Capital, $50,000. To operate a local light and power plant. Incorporators: J. W. Wright, Mason E. Brown, and J. B. Waugh.

Philadelphia, Pa. — Pennsylvania Electric Arc Welding Co. Capital, $10,000. Incorporated under Delaware laws to operate in electric welding. Incorporators: Clayton R. Plunkett, Albert Schroeder and George H. Beck, Philadelphia.

NEW PUBLICATIONS

Combustion Experiments with North Dakota Lignite.—A bulletin entitled, "Combustion Experiments With North Dakota Lignite," by Henry Kreisinger, C. E. Augustine and W. C. Harpster, has been issued by the Bureau of Mines, Department of the Interior. The Bureau of Mines is conducting an extensive investigation of methods of burning different fuels under power-plant boilers and in house-heating furnaces, with a view to effecting improvement of the methods or equipment, thus decreasing waste and promoting a more efficient utilization of fuel resources, and in this connection has issued a number of bulletins. This paper gives the results of combustion tests of North Dakota lignite burned in two forms—natural lignite as it comes from the mine and the carbonized residue from gas retorts. The tests were made by burning the fuels at various rates in experimental furnaces and by studying the processes of combustion. The information thus obtained was used in determining some of the general principles on which a successful furnace can be developed for use under power plant boilers and for house-heating apparatus. The bulletin is profusely illustrated with diagrams, charts, etc., and contains numerous tables, giving analyses of lignite. The price of this publication is 10 cents and copies may be obtained by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C.

Combustion and Flue Gas Analysis.—A very interesting and helpful publication for the power plant operator, engineers and others, entitled, "Combustion and Flue Gas Analysis," is being distributed by the Bureau of Mines, Department of the Interior. This is a reprint of Engineering Bulletin No. 4, prepared by the United States Fuel Administration in collaboration with the Bureau of Mines, and is based on an article by Joseph W. Hays, combustion engineer. It i s pointed out in this bulletin that from 25,000,000 to 50,000,000 tons of coal a year may be saved by the improved operation of industrial power plants without changing their present equipment, and without increasing their manufacturing output. The author discusses at some length the various phases of combustion and flue gas analysis and explains how the saving of fuel may be most effectively performed. Copies of this publication may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy.

Saving Steam in Industrial Heating Systems.—The Bureau of Mines, Department of the Interior, has issued Technical Paper 221 entitled "Saving Steam in Industrial Heating Systems." This is a reprint of engineering bulletin No. 6 prepared by the United States Fuel Administration in collaboration with the Bureau of Mines. A source of easily preventable loss incurred by many factories is that of the use of live steam for heating and for other purposes where exhaust steam would be at least as satisfactory. The manner in which the exhaust-steam problem is handled constitutes the great single determining factor in the economy of a steam plant. This bulletin calls attention to some faults of design and operation which lead to such an uneconomical use of live steam and describes the means for correcting them. The price of this publication is 5 cents, and copies may be obtained by addressing the Superintendent of Documents, Government Printing Office, Washington, D. C.

Boiler Water Treatment.—The Bureau of Mines, Department of the Interior, has issued Technical Paper 218, entitled "Boiler Water Treatment." This is a reprint of Engineering Bulletin No. 3, prepared by the United States Fuel Administration in collaboration with the Bureau of Mines. It discusses the nature and origin of scale formers in boiler water, dissolved matter which forms scale, the effect of scale, means of removing "scale formers" from water, and shows how a notable reduction in factory heat losses may be effected through the substitution of "softened" for "hard" boiler water.

PROPOSALS

Exhaust Blower.—Bids will be received by the county commissioners until May 5, 10 a. m., for an electric exhaust blower in the basement of the county-city building, Seattle, Wash. Plans may be examined at the office of the county commissioners.

Electric Light Outfit.—Bids will be received by the Superintendent of Lighthouses, Portland, Ore., until April 21, for one three-kw., 110-volt electric lighting outfit complete, consisting of internal combustion engine, generator, storage batteries, switches, etc. Specification 5649.

Motors and Parts.—Bids will be received by the Lighthouse Superintendent, Tompkinsville, N. Y., until April 23, for furnishing motors and parts for converting Niles bending rolls from belt to motor drive.

Electric Light Plant.—Bids will be received at Newkirk, Okla., about May 20 for rebuilding electric light and waterworks plants. This work involves 22,000 ft. 4-6 in. c. i. pipe, two 40-hp. motors and three 165-hp. oil engines. Cost about $170,000. H. G. Olmsted, city engineer.

Low-Voltage Systems.—Bids will be opened in the office of the Supervising Architect, Treasury Department, Washington, D. C., at 3. p. m., May 9, for a clock, fire-alarm, watchman's clock and low-voltage feeder systems in the Arlington building, Washington, D. C., in accordance with drawings and specifications, copies of which may be had at the above office in the discretion of the Supervising Architect, James A. Wetmore, Acting Supervising Architect.

Incandescent Lamps.—Bids will be received at Newark, N. J., April 21, for one year's supply of incandescent lamps at the several county institutions and buildings, in accordance with the specifications and form of proposal which will be furnished to bidders. Address George C. Bergen, purchasing agent.

Electric Exhaust Blower.—Bids will be received by county commissioners, Seattle, Wash., until May 5 at 10 a. m. for the installation of an electric exhaust blower. Plans are on file in the office of county commissioners.

Generator.—Bids will be received until 10 a. m., April 24, by the War Department, U. S. Soldiers' Home, Washington, D. C., for furnishing a 500-kw. generator.

Personal

Philip K. Condict Vice-President of International Western Electric—F. B. Jewett Awarded Service Medal—Changes

CHARLES R. EMERSON, formerly manager of the Boston and Philadelphia office of the Foster Engineering Co., manufacturer of automatic valve specialties, is now general sales manager of the company.

L. E. STROTHMAN, manager of the pumping engine and steam turbine departments, Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has been appointed to represent the American Society of Mechanical Engineers on the National Industrial Conference Board.

DUNCAN G. SINCLAIR, who was formerly chief assistant engineer of the Pittsburgh Railway Co. and the Duquesne Light Co., Pittsburgh, has accepted the appointment of New York manager for the Pitting Piping & Equipment Co., Pittsburgh, which has established an office in the St. Paul building, 220 Broadway, New York.

J. D. MOONEY, who was recently discharged from the army after having served overseas as a captain with the 309th Ammunition Train, 84th Division, has become connected with the General Motors Corporation, New York. In this capacity he will make a study, both in this country and abroad, of certain phases of the company's export business. Prior to joining the army in 1917 Mr. Mooney was manager of the industrial division of the Hyatt Roller Bearing Co.

C. R. YOUNG has resigned his position as sales manager of the Pacific Power & Light Co., Portland, Ore., to become associated with the securities selling department of the Electric Bond & Share Co., New York. Mr. Young joined the Portland company about eight years ago and for the past three years has been sales manager. During that time he had charge of all the company's sales campaigns, including the sale of preferred stock to the company's customers.

DR. FRANK B. JEWETT, chief engineer of the Western Electric Co. and late lieutenant-colonel in the Signal Corps, U. S. A., has been awarded the Distinguished Service Medal. The presentation took place at Washington, D. C., on April 5. The official citation follows: "By direction of the President and under the provision of the Act of Congress approved July 9, 1918, the Distinguished Service Medal is awarded to the following officers and civilians for exceptionally meritorious and conspicuous service: Frank B. Jewett, late lieutenant-colonel, Signal Corps, for exceptionally meritorious and conspicuous service in connection with the development of the radio telephone and the development and production of other technical apparatus for the Army." Dr. Jewett, shortly after the United States entered the war, received a commission as major in the Signal Officers' Reserve Corps. His promotion to the rank of lieutenant-colonel followed in the early part of 1918.

B. A. WAGNER, manager of the Electric Agencies Co., Inc., recently secured the Pacific Coast agencies for the Collyer Insulated Wire Co., manufacturer of rubber-covered and weatherproof wire, and the Tubular Woven Fabric Co., manufacturer of "Duraduct."

FRANK E. BOHN has been named general manager of the Home Telephone & Telegraph Co. to succeed William E. Moellering. Mr. Bohn has been assistant general manager for the past several years. Mr. Moellering has been serving as general manager in addition to his duties as president.

FRANK E. WATTS, of Frank E. Watts, Inc., sailed from New York on April 5 for London. He will remain abroad for three months covering all the major countries and establishing agents for his new electrical export association, also collecting samples of materials that are needed in European countries.

JAMES POSEY, who has been engaged in Government work, has reopened his engineering office at 925 Fidelity building, Baltimore. While working for the Government Mr. Posey designed and superintended the installation of heating, power plants, etc.; he also superintended the installation of the high-tension electrical distributions for the Bartlett-Hayward Co., Baltimore, and the Symington-Anderson Forge Co., Rochester. He has associated with him George W. Gail, Jr., who has been affiliated with the Bethlehem Steel Co. at Sparrow Point, Md., and the Curtiss Aeroplane Co., Buffalo.

PHILIP K. CONDICT, who until recently was in Government service, has been elected vice-president of the International Western Electric Co., Inc. In the early summer of 1917 Mr. Condict gave up his work as foreign sales manager for the company to take charge of the New York office of the War Trade Board, after a short stay with the Department of Commerce. In December, 1917, he received a commission as major in the Quartermasters' Corps, U. S. A., serving in that capacity until July, 1918. He was then detailed to the Signal Corps with the same rank and served in France until January.

BENJAMIN STALKER READ, of St. Louis, Mo., has been elected president of the Mountain States Telephone & Telegraph Co., with headquarters at Denver, Colo. In this new position he will succeed the late E. B. Field, Sr. Mr. Read has been manager of the Bell Telephone system in Missouri since 1912, with offices in St. Louis. For the last two years he has been operating vice-president of that organization in the southwestern division. Prior to going to St. Louis he acted as general manager of the telephone exchanges at Owensboro, Ky., Chattanooga, Tenn., Louisville, Ky., and New Orleans, La.

A. B. ELIAS has been appointed second vice-president of the Southwestern Bell Telephone Co. to succeed B. S. Read, who resigned to become president of the Mountain States Telephone & Telegraph Co., with headquarters at Denver, Colo. Mr. Elias has been general manager of the Bell system in Texas since July, 1917. In his new position he will have charge of the operation of the company's system in Missouri, Kansas, Arkansas, Oklahoma and Texas.

Obituary.

DAVID SWANK, builder of the Seattle & Rainier Valley railway and a part of the Seattle-Everett interurban, both electric traction lines, died in Seattle, April 3, at the age of 71. Born in Sandusky, Ohio, in 1848, he enlisted in the Union army at the age of 14, serving three years during the Civil war. Three of his sons served in the recent world war, one having been killed in action in France.

BURNETT C. KENYON, formerly president of the Diehl Manufacturing Co. and during the past two years purchasing agent for the Crocker-Wheeler Co., died suddenly from pneumonia at his home in East Orange, N. J., on April 5 at the age of 54 years. Mr. Kenyon had been associated with the electrical manufacturing industry for many years. He grew up in the Diehl company from salesman, through general managership to president. Before being employed with the Diehl company he was associated with the New York Electrical Equipment Co. Mr. Kenyon resigned from the presidency of the Diehl Manufacturing Co. about four years ago and after taking a long and well-deserved rest, he again entered business, becoming associated with the Crocker-Wheeler Co.

ANTOINE B. DU PONT, street railway expert, inventor, and engineer, died of pneumonia in Cleveland, Ohio, on April 11 from the effects of influenza. Mr. Du Pont, who was a brother of T. Coleman Du Pont, of New York, and of E. M. Du Pont, president of the street railway system of Johnstown, Pa., was the first manager of the Cleveland street railway system under the three cent fare plan of the late Mayor Tom L. Johnson. Mr. Du Pont was born at Louisville, on April 26, 1865, and was educated at Rensselaer Polytechnic Institute. After leaving school, he engaged in mining engineering, but eventually engaged in street railway work. He was associated with Tom L. Johnson in the management of street railways in Brooklyn, Louisville, Detroit, St. Louis, and Cleveland.

Financial News

Going Value of Public Utilities.

In an address delivered before the Maine Society of Civil Engineers, William B. Skelton discussed the principles adopted by the Maine Public Utilities Commission for valuation for rate making. Regarding "going values" he said:

"We have defined going value as 'an addition to physical value which is made to compensate a utility for losses during the development stage. By losses is meant that amount which the enterprise fails to pay expenses, and a fair return on the money invested.'

"Right here let me explain why I use the words 'money invested' instead of 'fair value,' or 'present value,' as a basis of fair return. It is because we regard going value as a matter of grace which should be allowed only to compensate for actual losses. It is no part of the physical cost of the property; it should be computed with great care; it is strictly an interest proposition, as we regard it.

"You will observe that I have spoken of 6% as a normal interest rate. The utility is entitled, if it can, to earn more than the normal interest rate on borrowed money. It is entitled to something for the risk of the undertaking and the care and attention required to make it a success. Money so invested is entitled to a maximum revenue greater than its owner would receive if he loaned it to another or invested it in securities and avoided the hazard and the annoyance of personal care of it. But we have felt that he must take that extra risk and pains during the development period, and have computed the going value allowance only at such rate as he could hire the money for.

"If at any time of the investigation it appears that the utility has, since the early losses were sustained, earned more than a fair maximum rate of return, such excess is deducted from the sum of the early losses, because it already has been made up by the public and need not then be capitalized.

"'Deficits continued indefinitely,' we have ruled, 'will not be permitted to be capitalized as going value. Such a practice would put too great a burden upon later customers of the utility, they would have to bear too much of the expense which was incurred in the service of those other years, or incurred before the investment was justifiable. When a utility once has reached a self-sustaining stage, the right to capitalize its deficits should cease, even though they be again suffered. This allowance is made for the expense of putting it on an earning basis; not for keeping it there.'

"Manifestly, the determination of the length of the development period over which such losses shall be capitalized must often be arbitrary. The most I can do is to state the general rule.

"You will have suspected what I have already said that we follow the historical method in fixing the allowance for going value. Volumes have been written in advocacy of different methods, and we have had elaborately constructed curves presented to us and able arguments in support of other systems. We have not yet been convinced that the historical method is not the preferable one. It puts upon the utility a difficult burden where accurate bookkeeping has not been in vogue but the corporations ought to keep full and correct accounts."

Minneapolis Company to Retire Bonds.

The Old Colony Trust Co., trustee, is advertising for tenders of the Minneapolis General Electric Co.'s 5% 30-year gold mortgage bonds, due Dec. 1, 1934, to absorb the sum of $75,616 in the sinking fund. Tenders will be received by the trustee at 17 Court street, Boston, until noon, April 21.

The St. Lawrence Transmission Co., Potsdam, N. Y., a subsidiary of the Aluminum Co. of America, Pittsburgh, has increased its capital from $525,000 to $3,000,000 to provide for proposed extensions in its electric system. F. A. Stoughton is president of the company.

Hawkeye Manufacturing Increases Capital Stock.

At a meeting of the stockholders of the Hawkeye Manufacturing Co. held recently, it was voted to increase the capital stock from $10,000 to $25,000, to provide for increasing the capacity of its plant to meet the growing need of its product. Officers elected are as follows: A. L. Cihok, president; John Reese, vice-president; and L. C. Burnett, secretary and treasurer.

Middle West Utilities Bond Issue.

A. B. Leach & Co., Inc., has purchased $500,000 five-year 7% convertible gold notes of the Middle West Utilities Co. and is offering them at 97 and interest, the yield upon the investment for five years being practically 7.75%. These notes are the obligation of one of the most stable and successful public utility companies in the country, and are secured by and are convertible into stocks of the important subsidiary companies. They are issued in coupon form, registrable as to principal only, in interchangeable denominations of $1000, $500 and $100. The proceeds of this issue will be used to reimburse the company for expenditures made and to be made in the development of its subsidiary companies as well as for such construction work as is necessary to secure economies in operation.

Westinghouse Sells British Holdings.

The Westinghouse Electric & Manufacturing Co. has practically completed plans for the sale of its British holdings. The sale was arranged by General Guy E. Tripp, chairman of the board; Charles A. Terry, vice-president, and several other officers of the Westinghouse company, who returned from Europe recently. The arrangements, it is said, call for a cash payment to the Westinghouse company for the British holdings, but no amount has been named. It is understood that the consideration is something in the neighborhood of $7,000,000.

There are several legal details in connection with the deal which remain to be straightened out, but these may be waived by the Westinghouse company if it is thought advisable. The plan also calls for a commercial alliance looking to the development of the export trade of the Westinghouse company. The British holdings of the Westinghouse Electric & Manufacturing Co. are securities of the Metropolitan Wagon, Carriage & Finance Corporation, Ltd., which were received by the Westinghouse company when it sold its interest in the British Westinghouse Electric & Manufacturing Co.

Preservation of Public Utilities.

The following paragraphs are quoted from an editorial under the caption, "This Is No Time to Treat Utilities Rough," which appeared in the Union of Indianapolis, Ind., April 4:

"The public has a tremendous stake in these public service companies. The impairment of their functions or their compulsory liquidation would work more havoc in this country than a financial panic. But every human precaution has been taken against a monetary panic while, generally speaking, no practical or considerate thought has been given to the preservation of the service companies without which the industrial and social and commercial life of this country could not be continued.

"No other element of the body politic is more interested in providing the public service companies with rates that will be compensatory than labor. Its interest is two-fold. It is concerned because it desires the permanence of the new wage scales that have been imposed upon those companies and labor knows that those scales cannot be maintained unless the corporations are given rates that will permit them to be paid; labor in all industry is concerned because it knows that ruin must follow the practice of imposing charges upon those companies that cannot be met with the existing income generally; the rate must be sufficient to preserve the physical equipment of the companies so that they may continue to function efficiently in the great work that must be performed in this country in getting rid of the debris of the war."

Idaho Power Shares Sold.

The sheriff has sold under a suit of execution all the rights, title and interest in 2877 shares of stock of the Idaho Power Co. and two notes aggregating $85,000 to satisfy a judgment for $10,551,525 obtained by the Bankers' Trust Co. against the National Security Corp., a Virginia corporation with offices at 71 Broadway, New York. The judgment was obtained against the company in the Supreme Court and represents the amount due on an issue of debenture bonds made on July 1, 1914, by the National Security Corp. The sale realized $363,011.

Cities Service Directors Re-elected.

At the annual meeting of Cities Service Co., held April 8, in Dover, Del., all retiring directors were re-elected.

The stockholders of the company approved the increase in the authorized amount of preferred capital stock from $100,000,000 to $150,000,000. None of this stock is to be presently issued, but it will be held for future corporate requirements of the company, including the conversion of $30,000,000 principal amount of 7% convertible gold debentures now outstanding.

Narragansett Electric Elects Officers.

At the recent annual meeting of stockholders of the Narragansett Electric Co., Providence, R. I., the following officers were elected for the ensuing year: President, Edwin A. Barrows; vice-president, William W. Douglas; secretary and treasurer, Franklin L. Hall; assistant secretary, Jesse E. Gay; assistant treasurer, Leslie F. Mowry, and general manager, Arthur B. Lisle.

Allis-Chalmers Profits Gain.

For the year ended Dec. 31, 1918, the Allis-Chalmers Co. earned net profits of $4,625,866 after all charges, but before preferred dividends, according to the annual financial statement just issued. This compares with $4,010,480 for the previous year before preferred dividends.

During the year 1918 there was declared on the preferred stock dividends amounting to $1,619,422, being the 7% regular and 3% on account of arrears. In 1917, $1,618,375 was paid.

The charges against total income including a provision of $4,540,000 for federal taxes and general contingencies, and an item of $579,882 for a special amortization reserve to apply on buildings, machinery and facilities installed by reason of war requirements. The income account compares as follows:

	1918.	1917.
Sales billed	$35,031,233	$26,129,117
Cost, including depreciation and development expenditures	23,339,430	19,144,107
Factory profit	$11,691,803	$ 6,985,210
Selling, publicity, administrative and general expenses	2,220,166	1,906,264
Manufacturing profit	$ 9,471,636	$ 5,078,946
Add—Other income: Interest, discounts, royalties, commissions, etc.	283,112	229,844
Total profit and income	$ 9,754,748	$ 5,309,790
Deduct: Preferred dividends		1,618,375
Federal taxes, general contingencies, special amortization	5,128,882	1,298,300
Net profit	$ 4,625,866	$ 2,392,115

For the Readjustment Period—What?

XXXIII.

LOOKING SOUTH

The delegates from the Chicago Association of Commerce now visiting Mexico by special train in response to an invitation from President Carranza write that they are greatly impressed by the cordiality of their reception. They have met with no indications of that hostility to Americans which was supposed to be widespread in the southern republic. All the business men and officials with whom they have come in contact appear to realize the advantages of a better understanding and closer trade relations between the two countries. In the days before the revolution, when the progress that had been made under the Diaz regime was prominently before men's minds, the attitude of both nations was friendly. Then came the revolutionary period in Mexico, with its constant friction, and for a time good relations ceased. But in large sections of Mexico individual Americans went about their business without meeting with any particular evidence of personal hostility from the Mexicans.

The great fact to be grasped and acted on by both Americans and Mexicans who desire to improve trade relations is that the sentiment of the two countries is largely what they themselves choose to make it. If they are willing to exert themselves to agree with each other and to make their relations beneficial to both sides, they will set an example likely to produce happy results. Sentimental considerations follow the flag of material advantage, and usually at no great distance.

Canada, prosperous and orderly, is our best customer; Mexico, in distress, is among our worst. By helping Mexico, we shall be helping ourselves.

C. A. TUPPER *President*
INTERNATIONAL TRADE PRESS, INC., CHICAGO

Bonnot Company Increases Capital.

An increase in its capitalization from $500,000 to $1,000,000 is announced by the Bonnot Co., Canton, Ohio, manufacturer of the Holbeck pulverized coal system and other machinery. The company was incorporated in 1891 for $100,000, which amount was increased in 1916 to $500,000. This increase is in the form of 7% preferred stock, the proceeds of which will be used as working capital. The officers of the company are: L. C. Bonnot, president; Henry W. Harter, vice-president; A. A. Oldham, secretary and treasurer.

The Missouri Senate has confirmed the reappointment of William G. Busby, chairman of the Missouri Public Utilities Commission, and Edwin J. Bean, members of the Commission. Each was reappointed for a period of six years. Announcement was also made that R. P. Spencer, of St. Louis, actuary of the state insurance department, will succeed A. Z. Patterson as chief counsel for the Commission.

Dividends.

Edison Electric Illuminating Co. of Boston has declared a quarterly dividend of $3, payable May 1 to stockholders of record April 15.

Keystone Telephone Co. has declared a semi-annual dividend of 3% on preferred stock, payable May 1 to stock of record April 19.

Electric Bond & Share Co. has declared a quarterly dividend of 1½% on preferred stock, payable May 1 to stock of record April 16.

Pacific Gas & Electric Co. has declared a quarterly dividend of $4.25, payable April 21, to stock of record April 8.

A quarterly dividend of ½ of 1% on common stock has been declared by the Carolina Power & Light Co., payable May 1 to stockholders of record April 15.

Earnings.

TAMPA ELECTRIC.

Gross earnings:	1919.	1918.
February	$ 102,948	$ 87,102
12 months	1,096,592	992,188
Net earnings:		
February	44,221	39,799
12 months	457,293	422,482

KEYSTONE TELEPHONE CO.

The Keystone Telephone Co. has issued its comparative statement of earnings for the month ended Feb. 28 and for the two months ended on that date, as follows:

	For month ended Feb. 28, 1919.	Year Previous.
Gross earnings	$129,412	$134,479
Operating expen., taxes	84,437	75,825
Net earnings	$ 44,975	$ 58,654
Less interest charges	29,105	28,372
Surplus and reserve	$ 15,870	$ 30,282
	For 2 months ended Feb. 28, 1919.	Year Previous.
Gross earnings	$261,378	$270,998
Operating expens., taxes	170,091	154,734
Net earnings	$ 91,287	$116,264
Less interest charges	58,526	56,725
Dividends	.....	48,422
Surplus and reserve	$ 32,761	$ 11,117

AMERICAN RAILWAYS.

The company and subsidiaries report for year ended Dec. 31:

	1918.	1917.	1916.
Gross	$14,234,404	$12,863,404	$8,840,913
Net	3,663,256	3,692,820	3,426,108
Surplus after charges	1,045,295	1,299,951	1,823,366

The Aurora, Elgin & Chicago Railroad Co. showed a deficit for the month of February, but the deficit was smaller than for February, 1918. The reports compare: Total earnings, February, 1919, $179,364; February, 1918, $140,915. Operating expenses and taxes, February, 1919, $152,361; February, 1918, $123,038. Net earnings, February, 1919, $27,002; February, 1918, $17,786. Deficit, February, 1919, $21,075; February, 1918, $24,576.

UNITED RAILWAYS & ELECTRIC.

Surplus after charges and taxes for 1918, $332,652, equivalent after preferred dividends, to 81 cents a share, as compared with $875,586, or $2.13 a share in 1917.

PHILADELPHIA ELECTRIC CO.

Earnings for the year ended, Dec. 31, 1918, show a surplus after charges and federal taxes, $10,282,870, equivalent to $2.03 a share, against surplus of $2,018.94, or $2.01 a share in 1917.

MIDDLE WEST UTILITIES.

The aggregate earnings of all the subsidiaries of the Middle West Utilities Co. for 1919 are as follows:

Gross earnings	$7,093,100
Operating expenses	4,628,300
Net earnings	$2,464,800
Bond and collateral note interest	1,304,200
Balance	$1,160,600
Deductions from income	296,200
Balance for dividends	$ 864,400
6% on $7,559,800 outstanding preferred stock	453,588
Balance	$ 410,812

AMERICAN DISTRICT TELEGRAPH.

(And its controlled companies.)

The comparative income account for years ended Dec. 31, 1918 and 1917, is as follows:

	1918.	1917.
Gross operating revenues and income	$3,377,889.66	$3,212,367.92
Operating expenses, including depreciation and lease of plants, miscellaneous interest, etc.	2,955,359.91	2,424,378.64
Balance	$ 422,529.75	$ 787,989.28
Deduct — Interest on bonds of the American District Telegraph Company (N. J.)	12,075.56	12,607.91
Balance transferred to surplus account	$ 410,454.19	$ 775,381.37

NEW ENGLAND POWER SYSTEM.

The report of the New England Power System for 1918, shows operating results which compare as follows:

	1918.	1917.
Gross earnings	$2,557,281	$2,645,973
Expenses and taxes	2,234,400	1,501,778
Net earnings	$1,322,881	$1,144,195
Bond interest	463,919	440,963
Other interest	200,750	156,722
Balance	$ 658,212	$ 546,450
First preferred dividend	293,226	278,411
Second preferred dividend	108,800	108,800
Surplus	$ 256,186	$ 159,239

PENNSYLVANIA UTILITIES SYSTEM.

Item.	February 1919.	February 1918
Operating revenues	$149,296.58	$124,753.42
Operating expenses and taxes	100,144.86	94,645.39
Operating income	$ 49,151.72	$ 30,108.03

Income applicable to bond interest, 12 months ended Feb. 28, 1919:

Gross revenue (including other income)	$1,666,569.36
Operating expenses, taxes, rentals and miscellaneous deductions of Eastern Pennsylvania Power Co. and Eastern Gas Works	1,264,882.56
Balance	$ 401,686.80
Interest:	
On $742,000 Eastern Gas Works Bonds, 5%	$37,100.00
On Pennsylvania Utilities Co. first mortgage bonds, $3,166,000 outstanding, 5%	158,300.00
$581,000 issued but not sold, 5%	29,050.00
Total first mortgage interest	224,450.00
Balance	$ 177,236.80
Interest on $1,225,000 of Pennsylvania Utilities Co. 6% second mortgage notes	73,500.00
	$ 103,736.80

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeiler & Co., Rookery Bldg., Chicago.

Public Utilities.	Div. rate. Per cent.	Bid Apr. 8.	Bid Apr. 15.
Adirondack Electric Power of Glens Falls, common	6	12	13½
Adirondack Electric Power of Glens Falls, preferred	6	72	74
American Gas & Electric of New York, common	10+extra	119	119
American Gas & Electric of New York, preferred	6	41	41
American Light & Traction of New York, common	..	240	240
American Light & Traction of New York, preferred	6	99	99
American Power & Light of New York, common	4	54	55
American Power & Light of New York, preferred	6	74	72
American Public Utilities of Grand Rapids, common	..	10	10
American Public Utilities of Grand Rapids, preferred	7	30	30
American Telephone & Telegraph of New York	..	104¾	105
American Water Works & Elec. of New York, common	..	5	5
American Water Works & Elec. of New York, particip.	7	10	10
American Water Works & Elec. of New York, first preferred	..	62	59
Appalachian Power, common	..	2	2
Appalachian Power, preferred	7	12	10
Cities Service of New York, common	+extra	358	358
Cities Service of New York, preferred	6	79¼	79¼
Commonwealth Edison of Chicago	8	114	114¼
Comm. Power, Railway & Light of Jackson, common	..	23	22
Comm. Power, Railway & Light of Jackson, preferred	6	44½	45
Federal Light & Traction of New York, common	..	9	10
Federal Light & Traction of New York, preferred	..	44	46
Illinois Northern Utilities of Dixon	6	..	..
Middle West Utilities of Chicago, common	2+extra	25	26
Middle West Utilities of Chicago, preferred	6	51	52
Northern States Power of Chicago, common	..	70	70
Northern States Power of Chicago, preferred	ex.div.7	89	89
Pacific Gas & Electric of San Francisco, common	..	52	56
Pacific Gas & Electric of San Francisco, preferred	6	87	87
Public Service of Northern Illinois, Chicago, common	7	95	95
Public Service of Northern Illinois, Chicago, preferred	6	90	90
Republic Railway & Light of Youngstown, common	4	20	22
Republic Railway & Light of Youngstown, preferred	6	59	60
Standard Gas & Electric of Chicago, common	..	28	..
Standard Gas & Electric of Chicago, preferred	6	42	42
Tennessee Railway, Light & Power of Chattanooga, common	..	5	4½
Tennessee Railway, Light & Power of Chattanooga, preferred	6	22	21
United Light & Railways of Grand Rapids, common	4	40½	40½
United Light & Railways of Grand Rapids, preferred	6	71½	71½
Western Power of San Francisco, common	..	16½	17
Western Union Telegraph of New York	extra	87	86½
Industries—			
Electric Storage of Philadelphia, common	4	69	69½
General Electric of Schenectady	8	156	161
Westinghouse Electric & Mfg. of Pittsburgh, common	7	45½	46½
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	55	55